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CPC ..... Y10T 292/0889; Y10T 292/089; Y10T  
292/0893; Y10T 292/0913; Y10T  
292/0914; Y10T 292/0915; Y10T  
292/0917  
USPC ..... 220/326, 830, 827, 828, 810  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,997,052 A \* 12/1999 Reeb ..... E05B 15/0093  
292/148  
11,459,171 B2 \* 10/2022 Reeb ..... B65F 1/1615  
2009/0066092 A1 \* 3/2009 Reeb ..... B65F 1/1615  
292/184  
2014/0306465 A1 \* 10/2014 Kreitzer ..... E05F 1/002  
292/305  
2015/0314957 A1 11/2015 Reeb  
2016/0355334 A1 \* 12/2016 Reeb ..... E05B 65/52  
2017/0190509 A1 7/2017 Reeb et al.  
2017/0320665 A1 11/2017 Reeb et al.  
2018/0371802 A1 \* 12/2018 Rodaer ..... E05B 67/24  
2019/0106278 A1 4/2019 Reeb et al.

\* cited by examiner

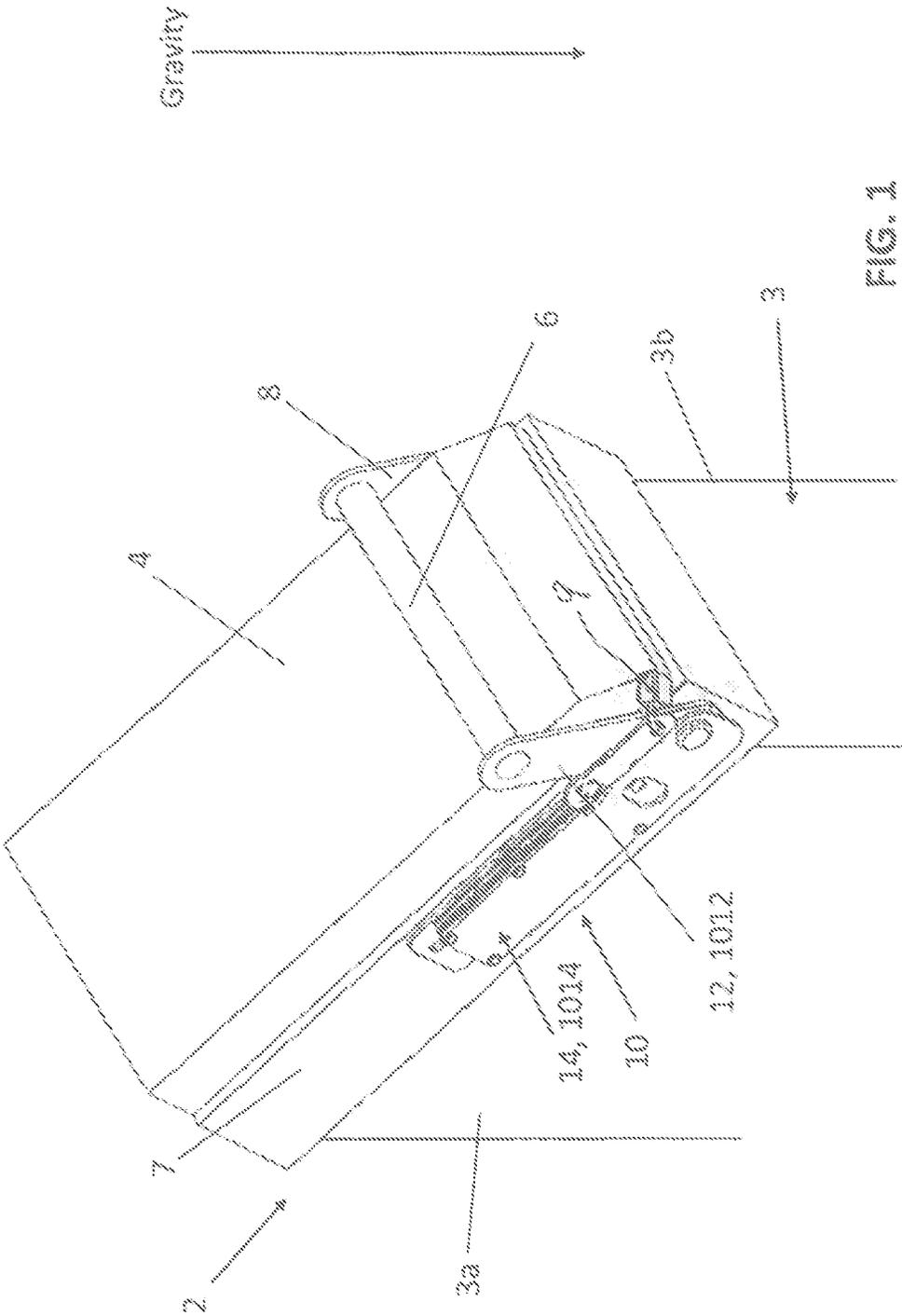


FIG. 1

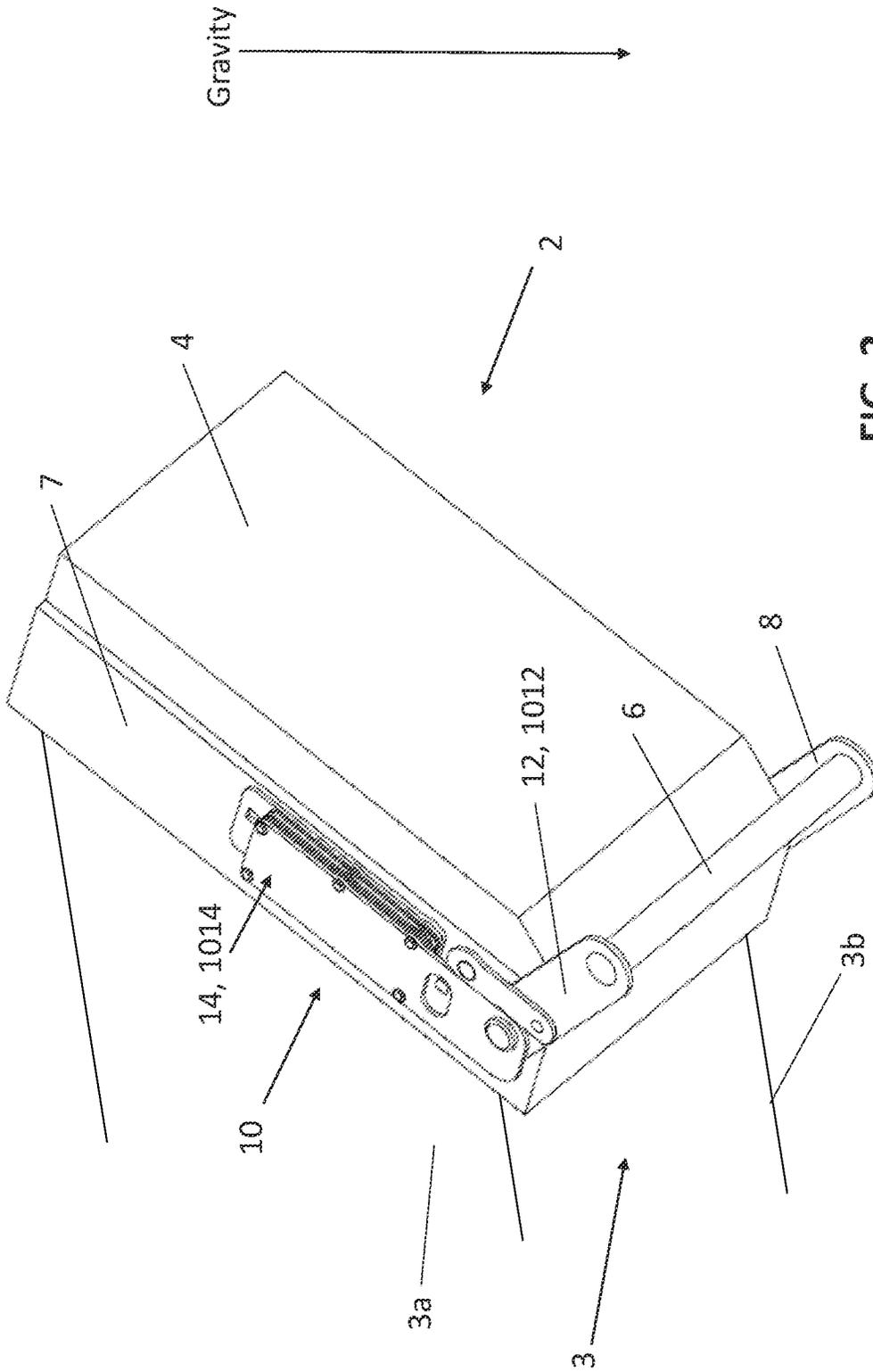


FIG. 2

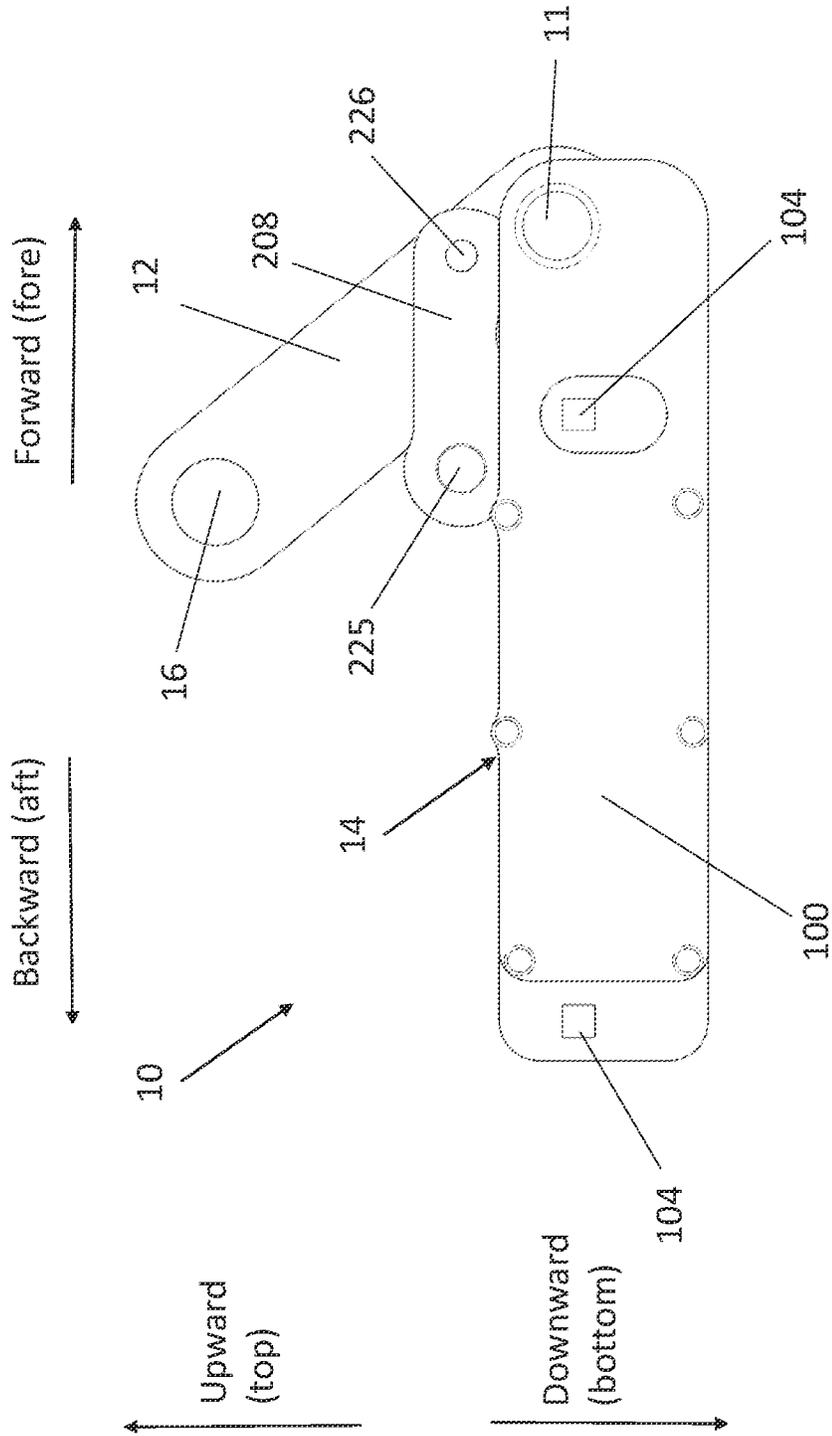


FIG. 3

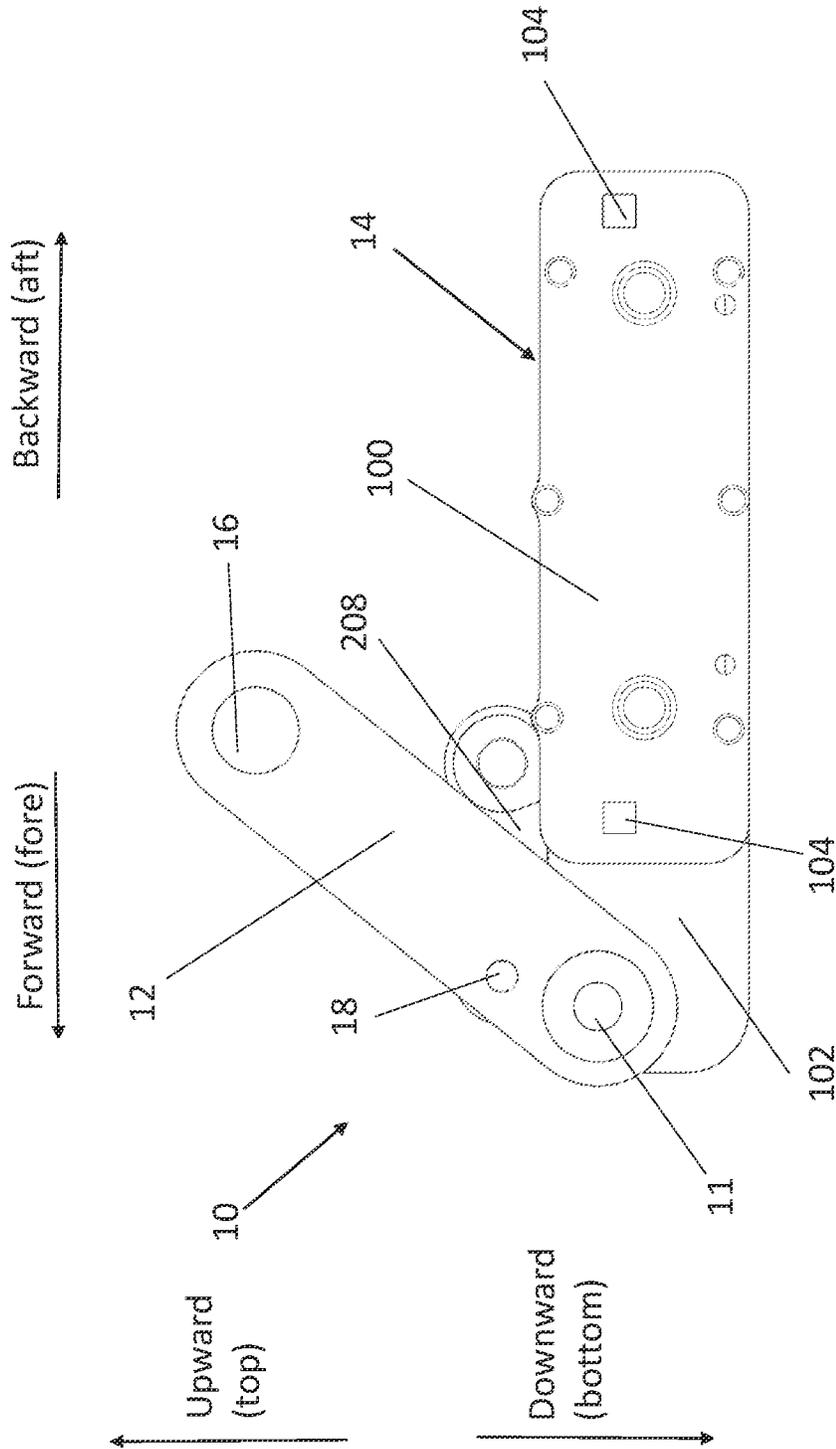


FIG. 4

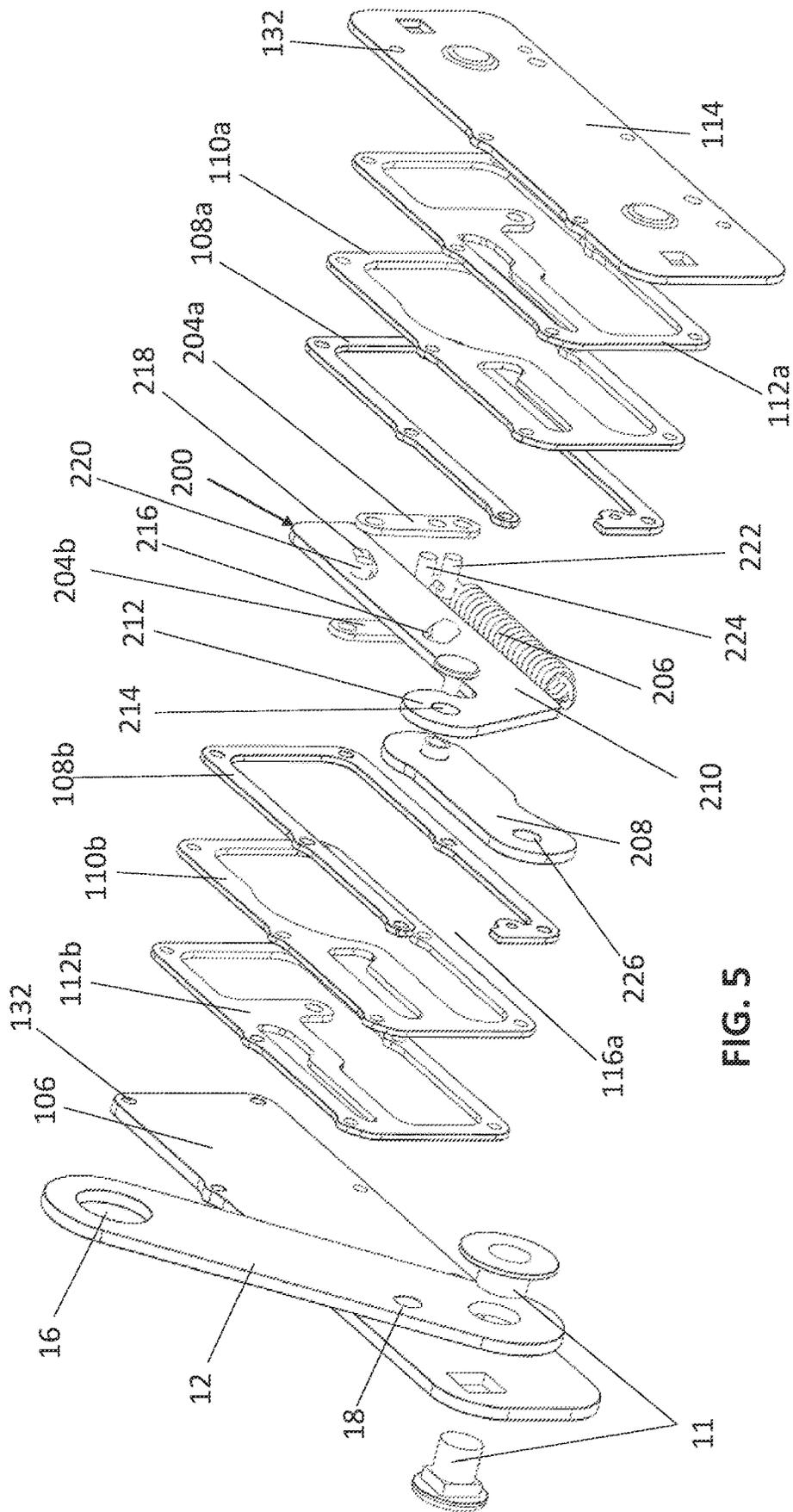


FIG. 5

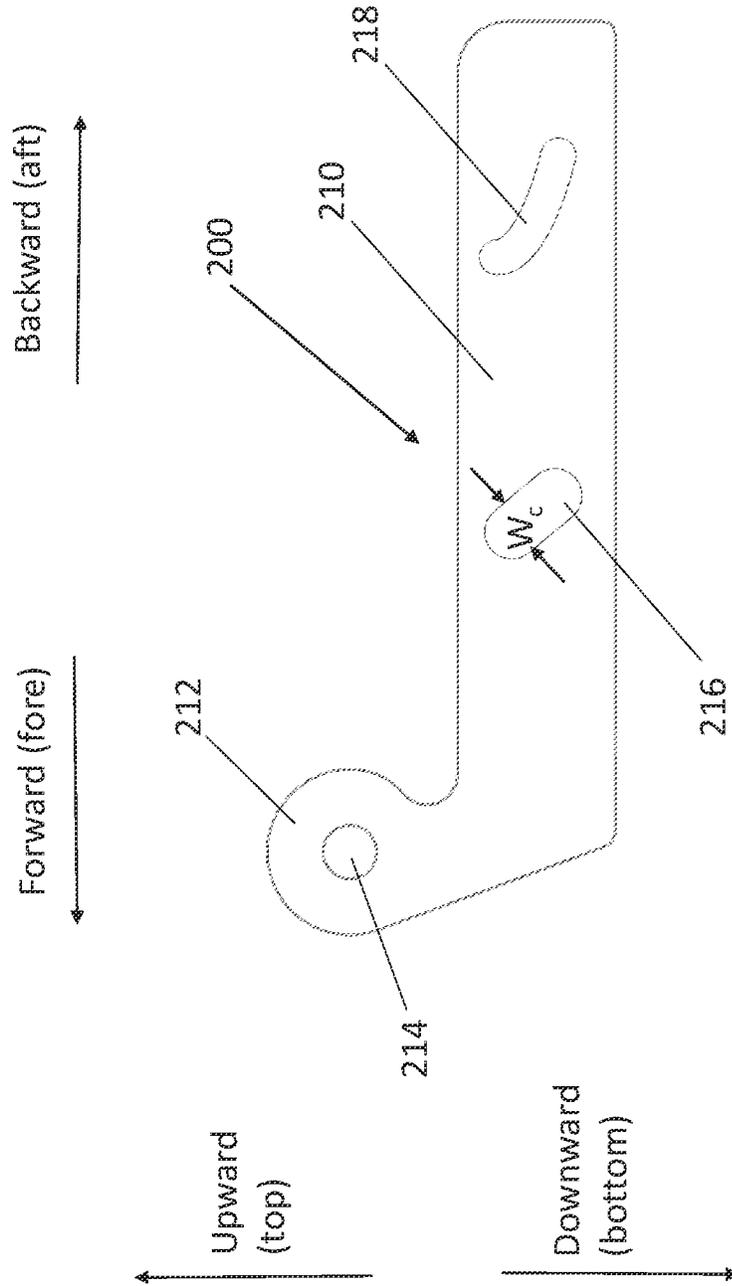


FIG. 6

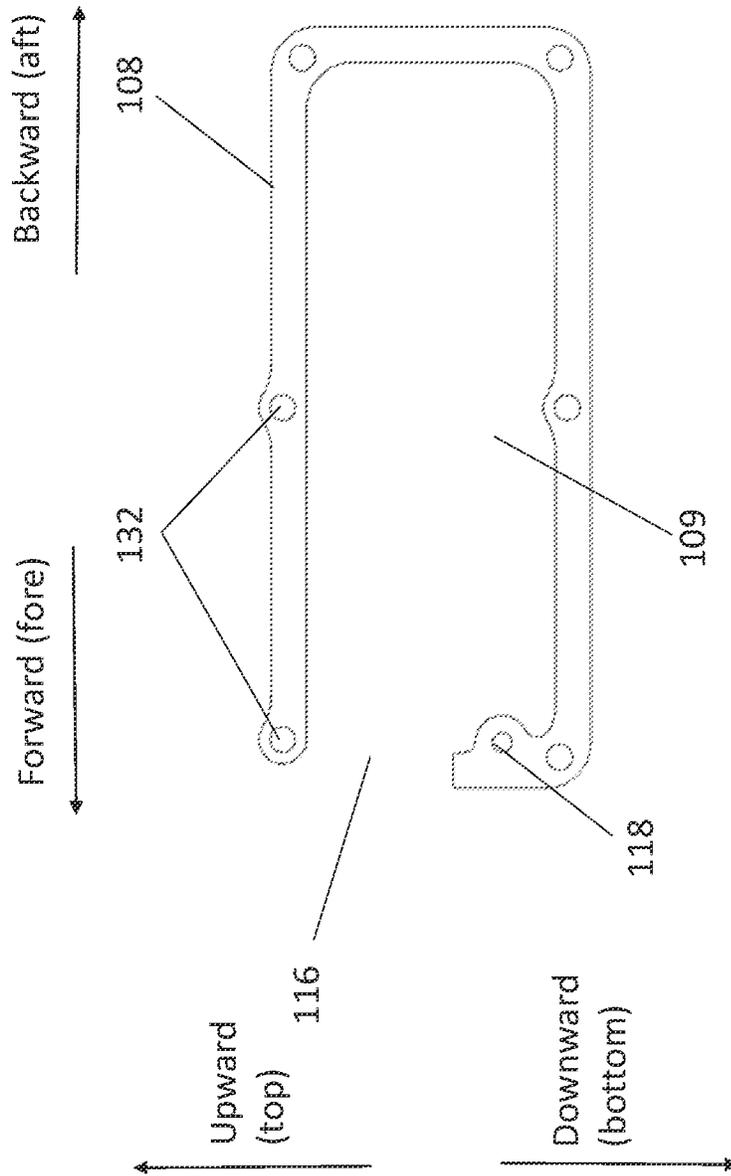


FIG. 7

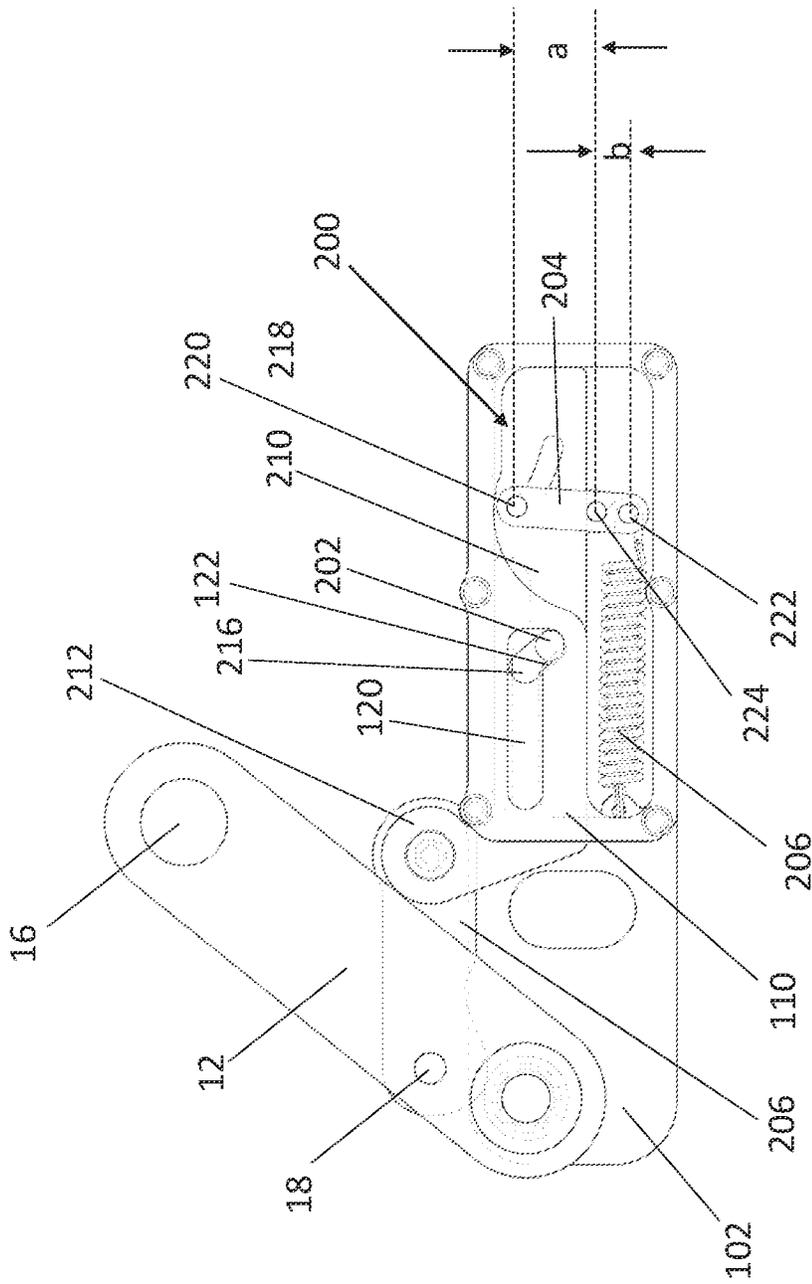


FIG. 8

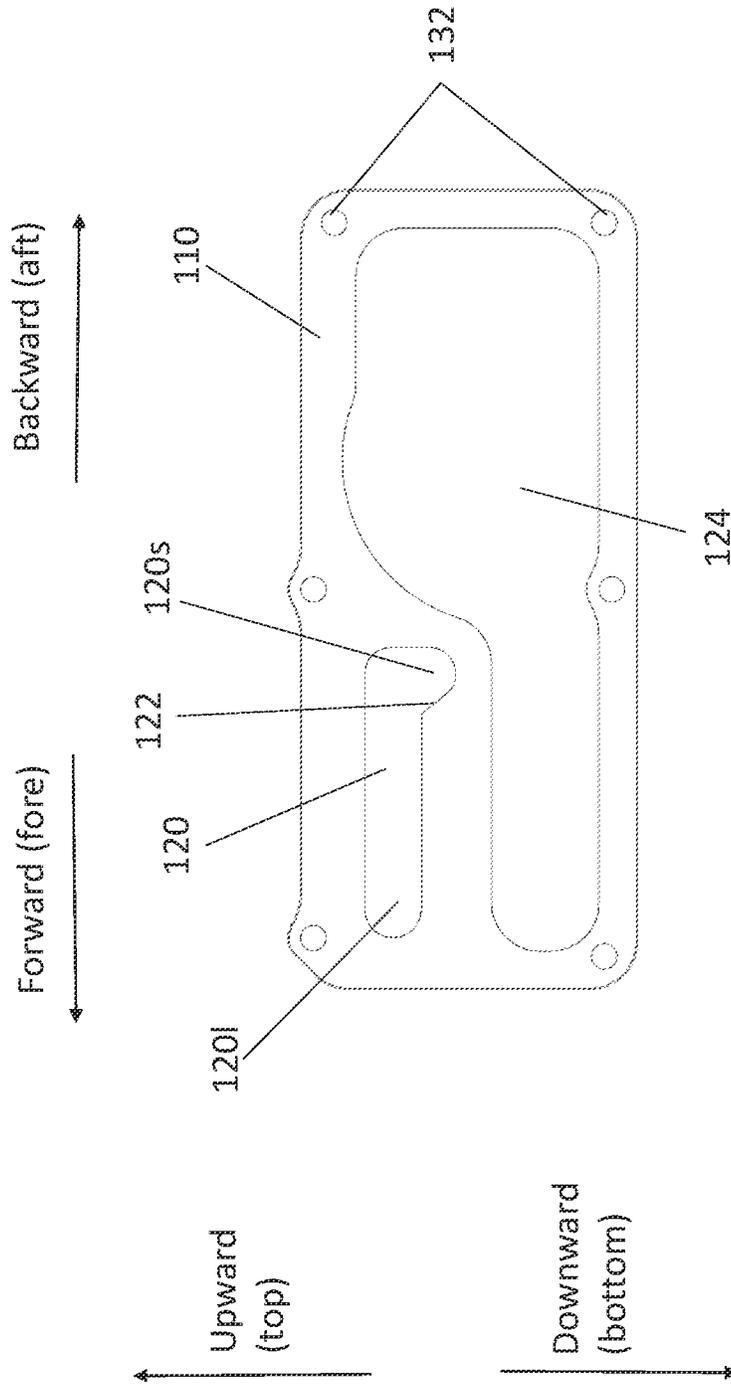


FIG. 9

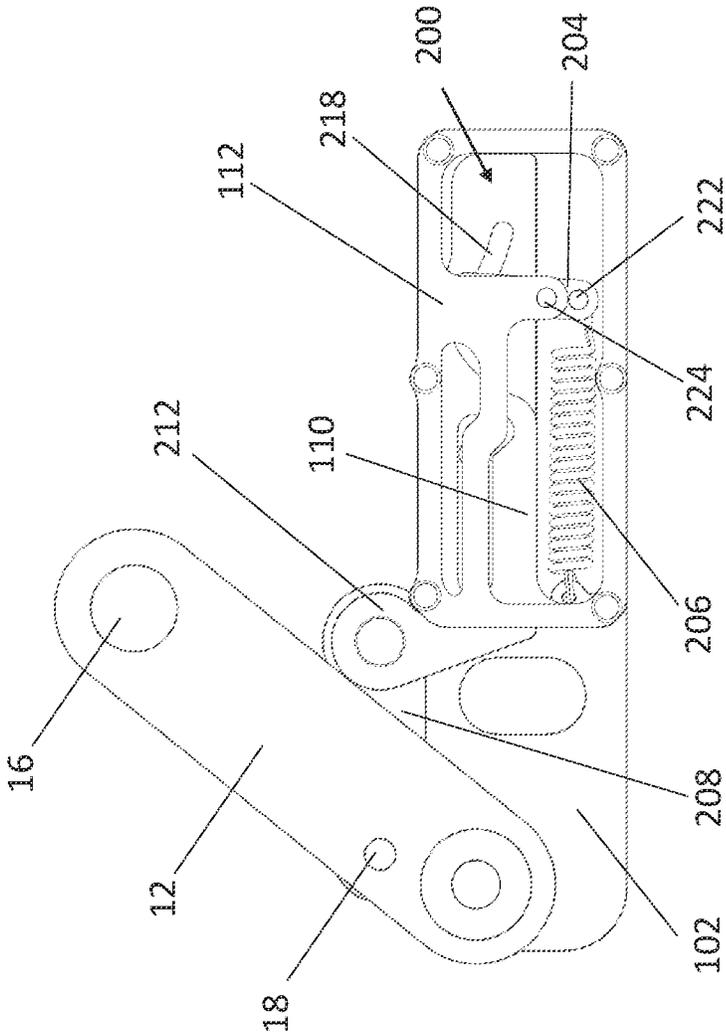


FIG. 10

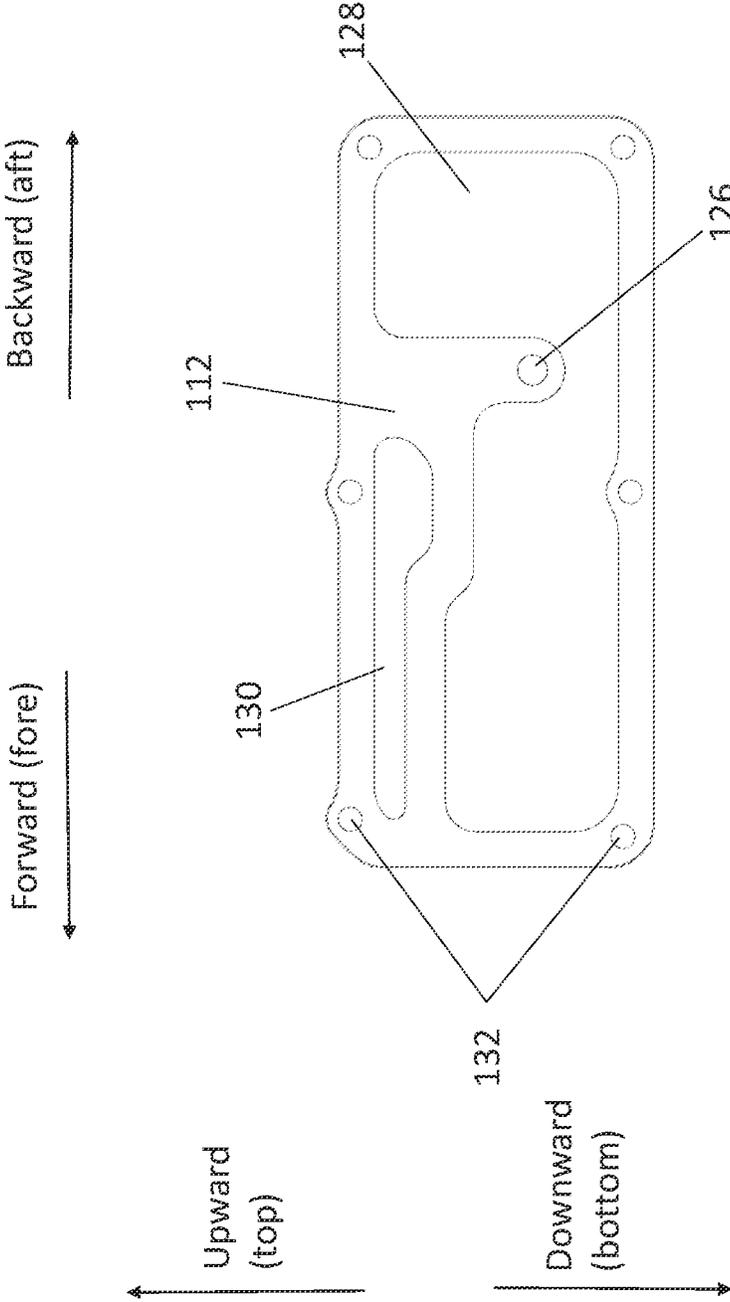


FIG. 11

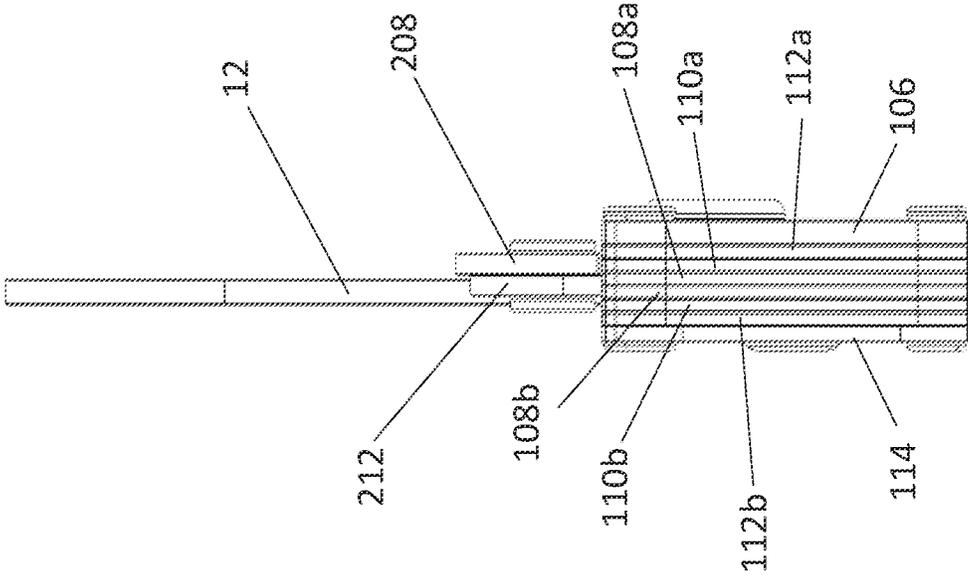


FIG. 12

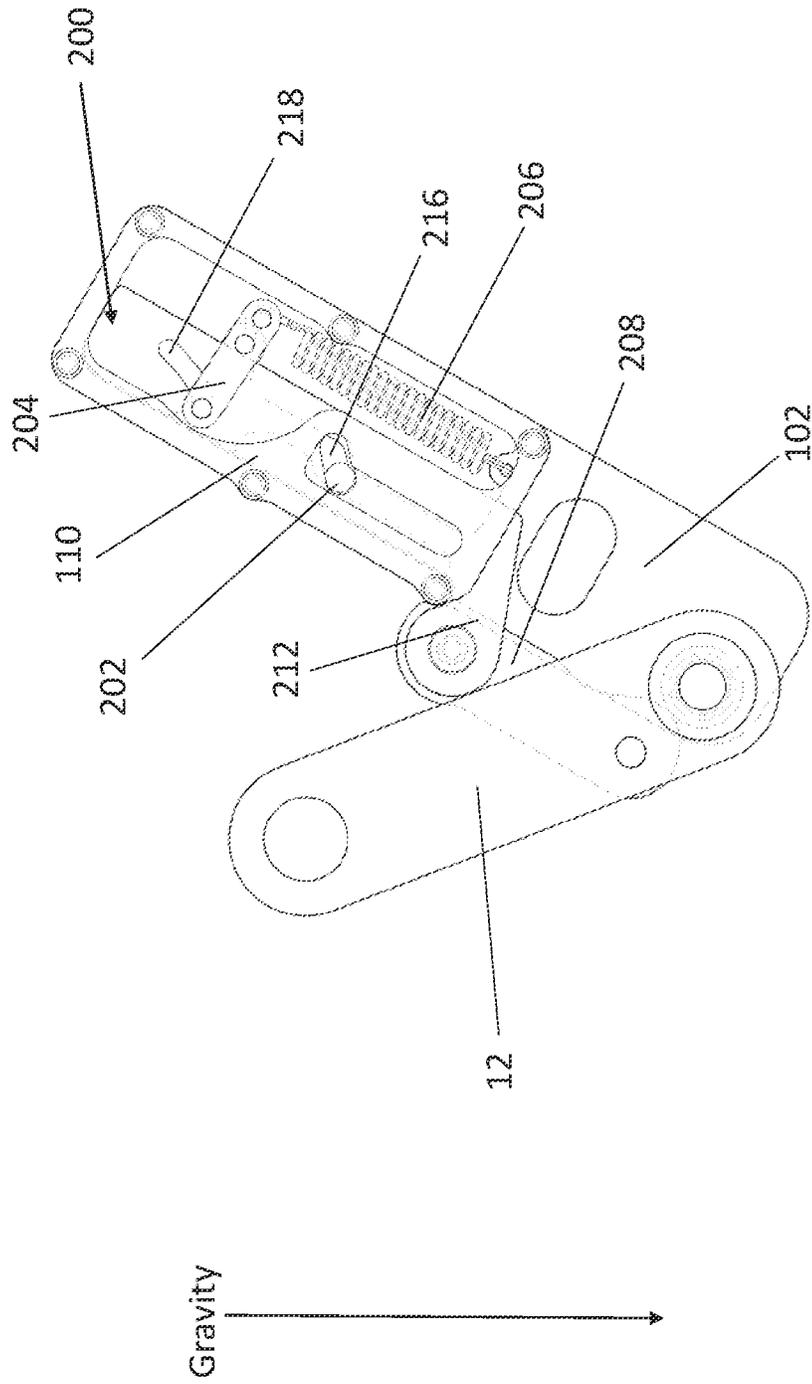


FIG. 13

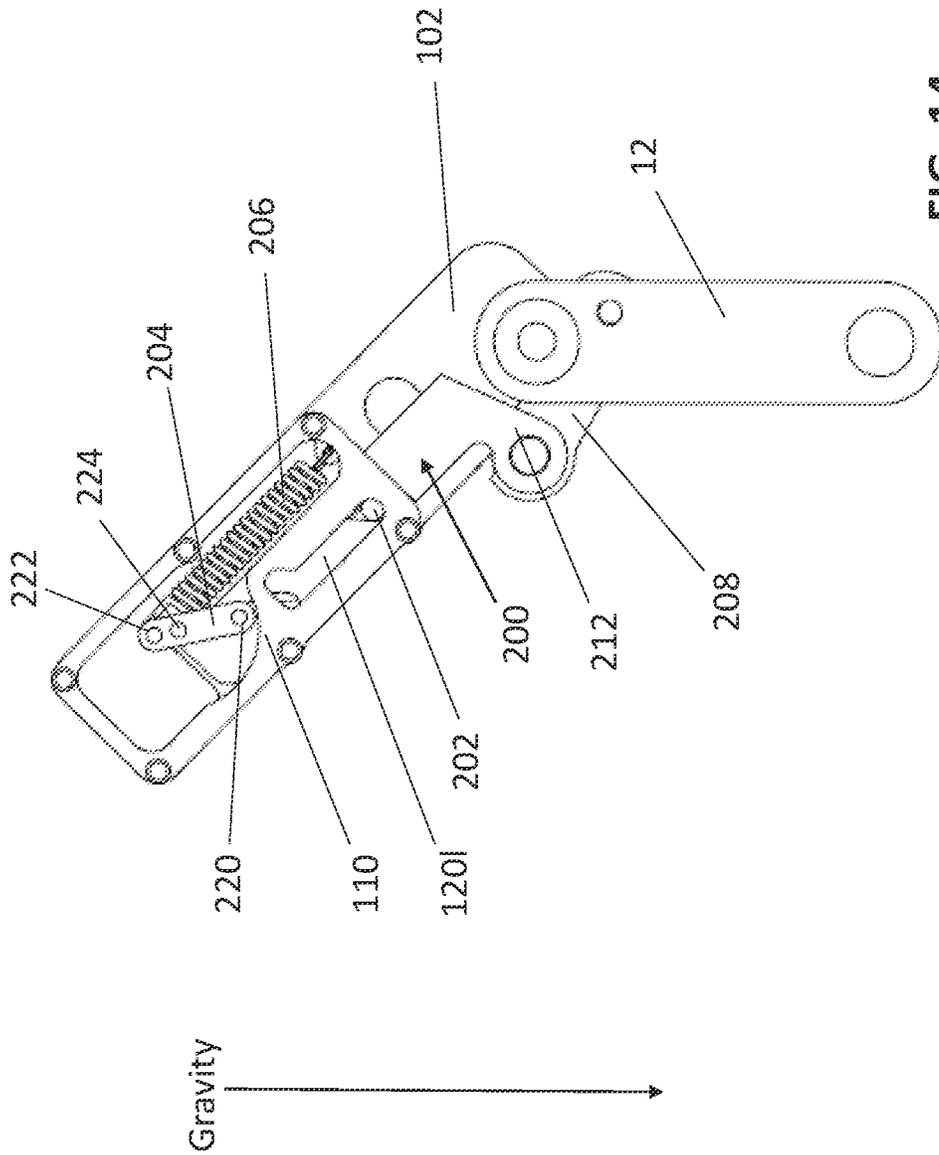


FIG. 14

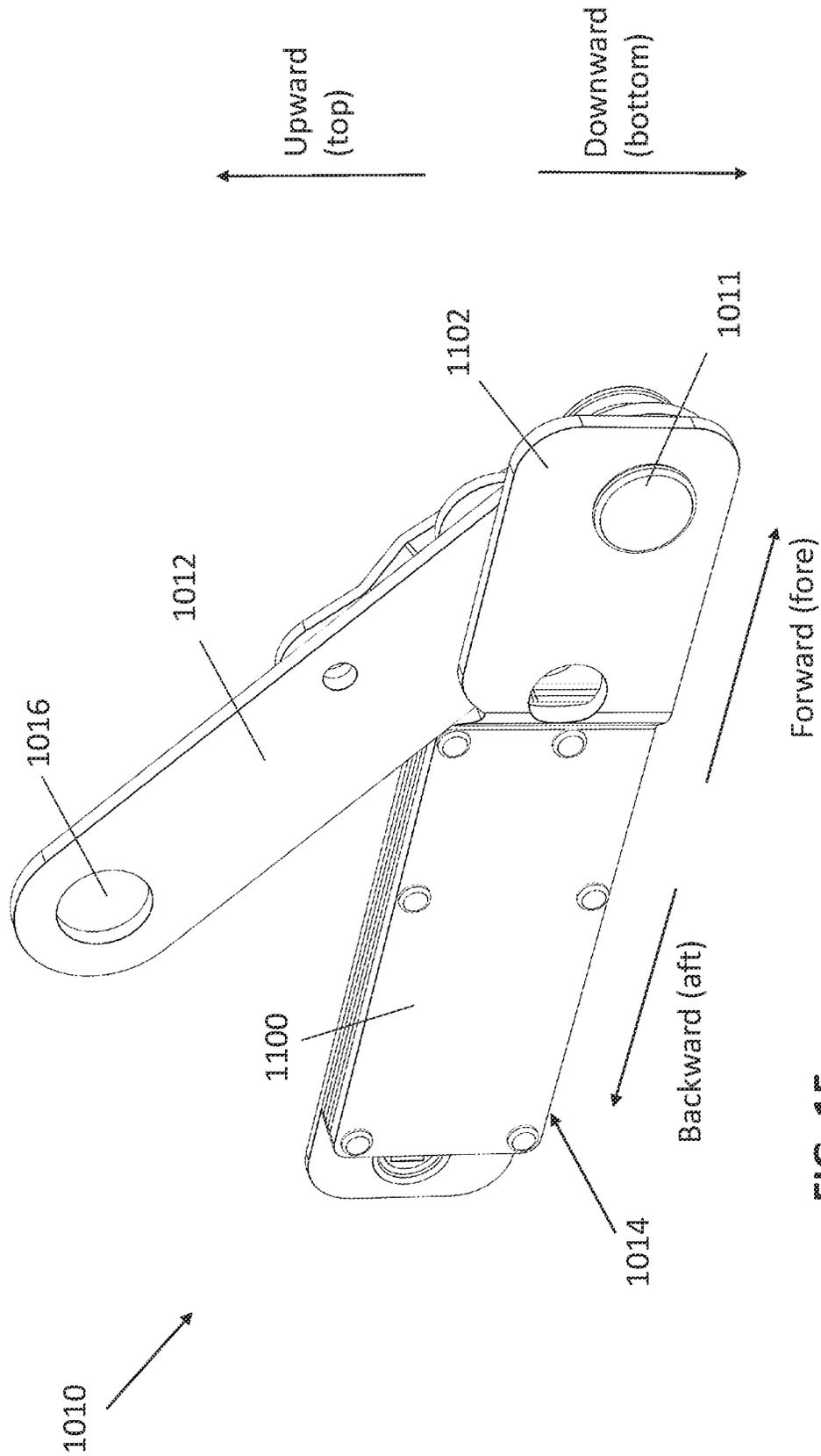


FIG. 15

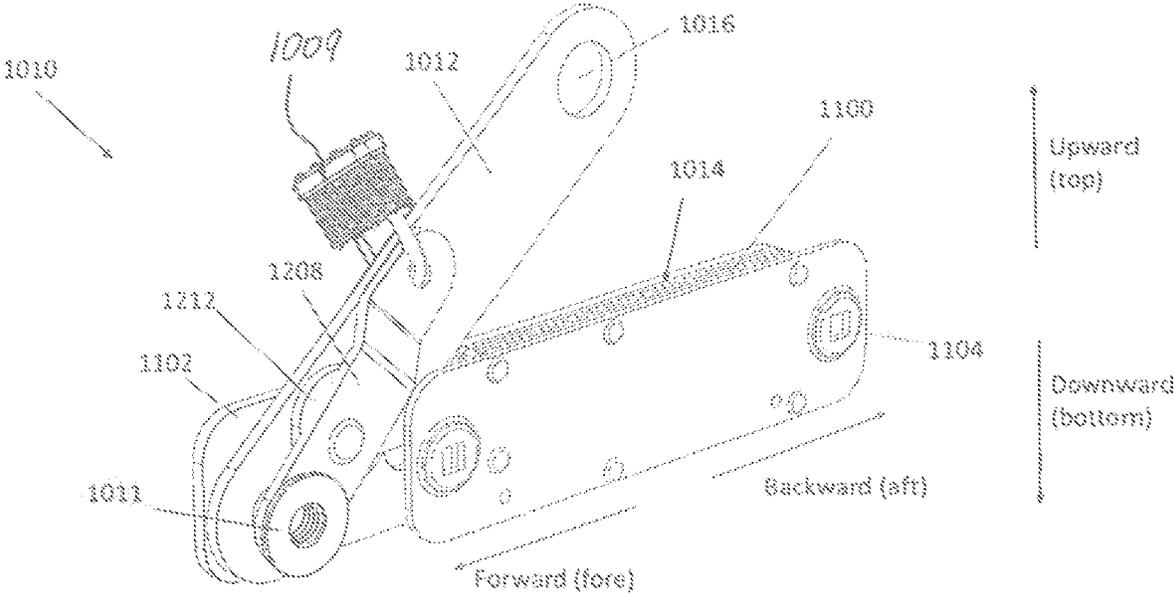


FIG. 16

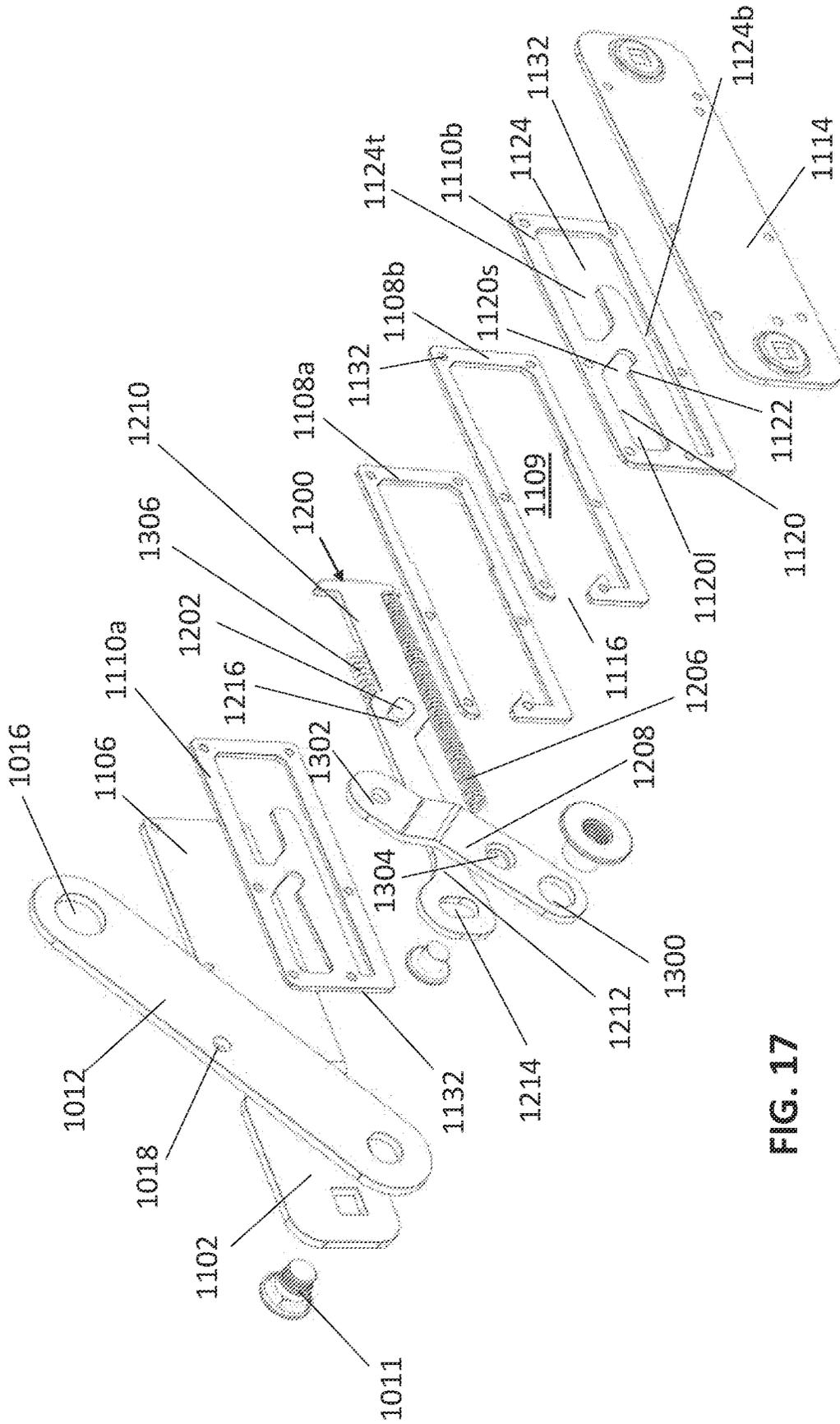


FIG. 17

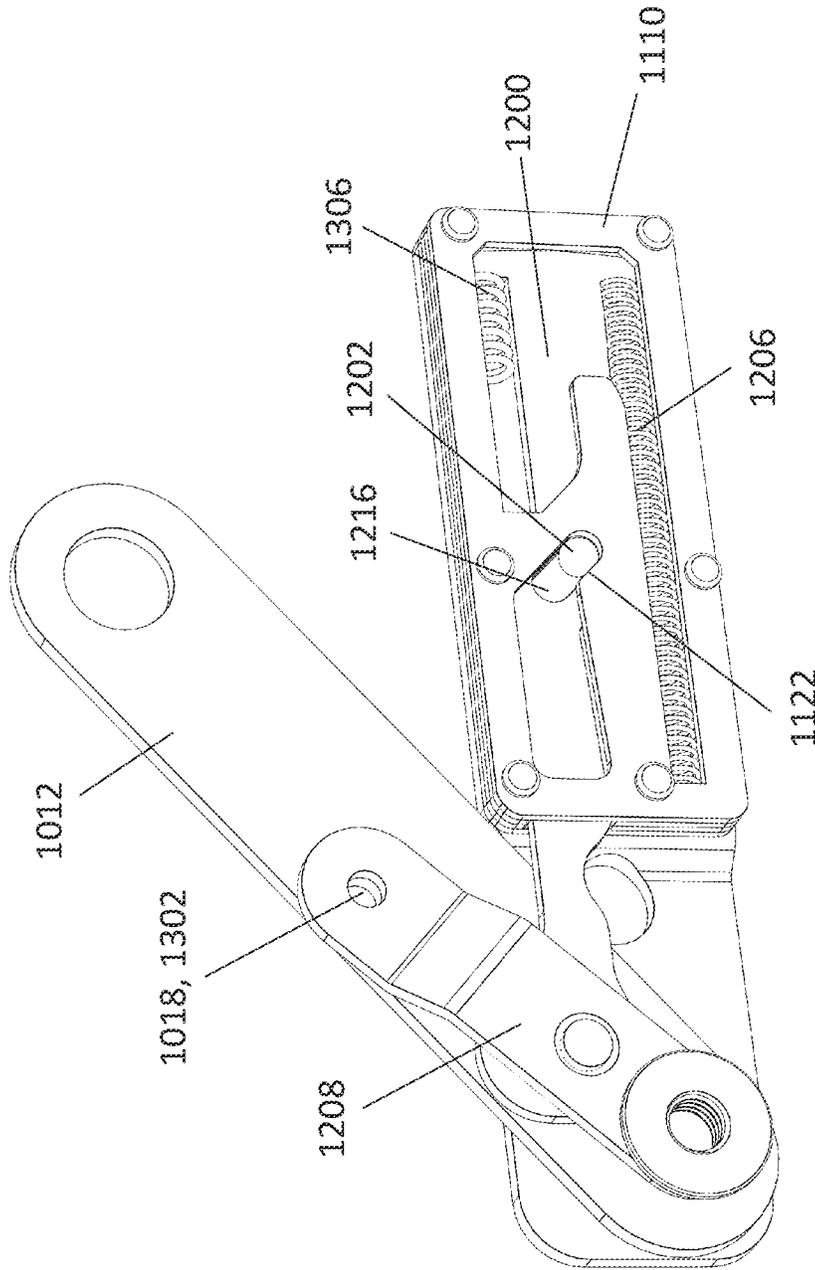


FIG. 18

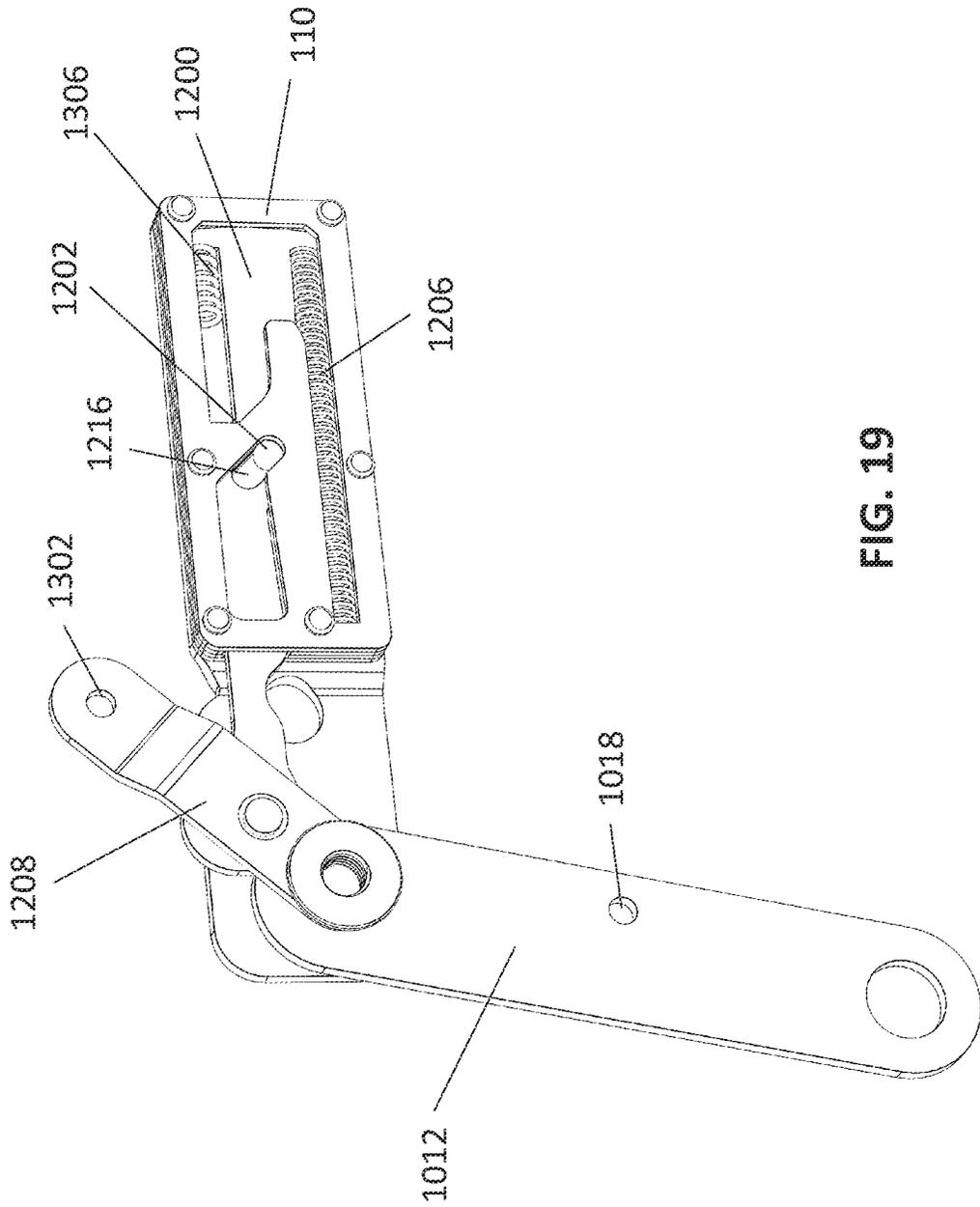


FIG. 19

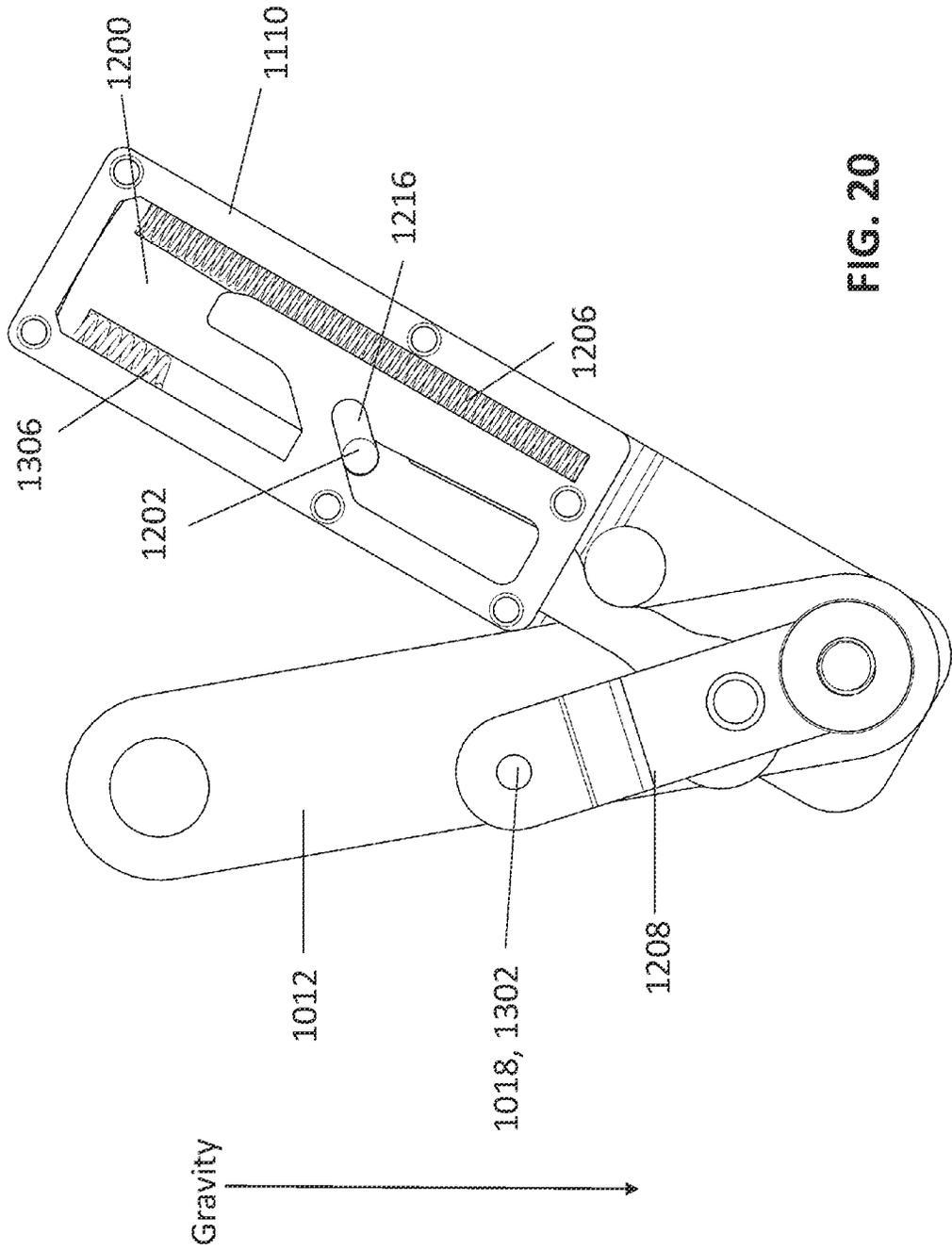
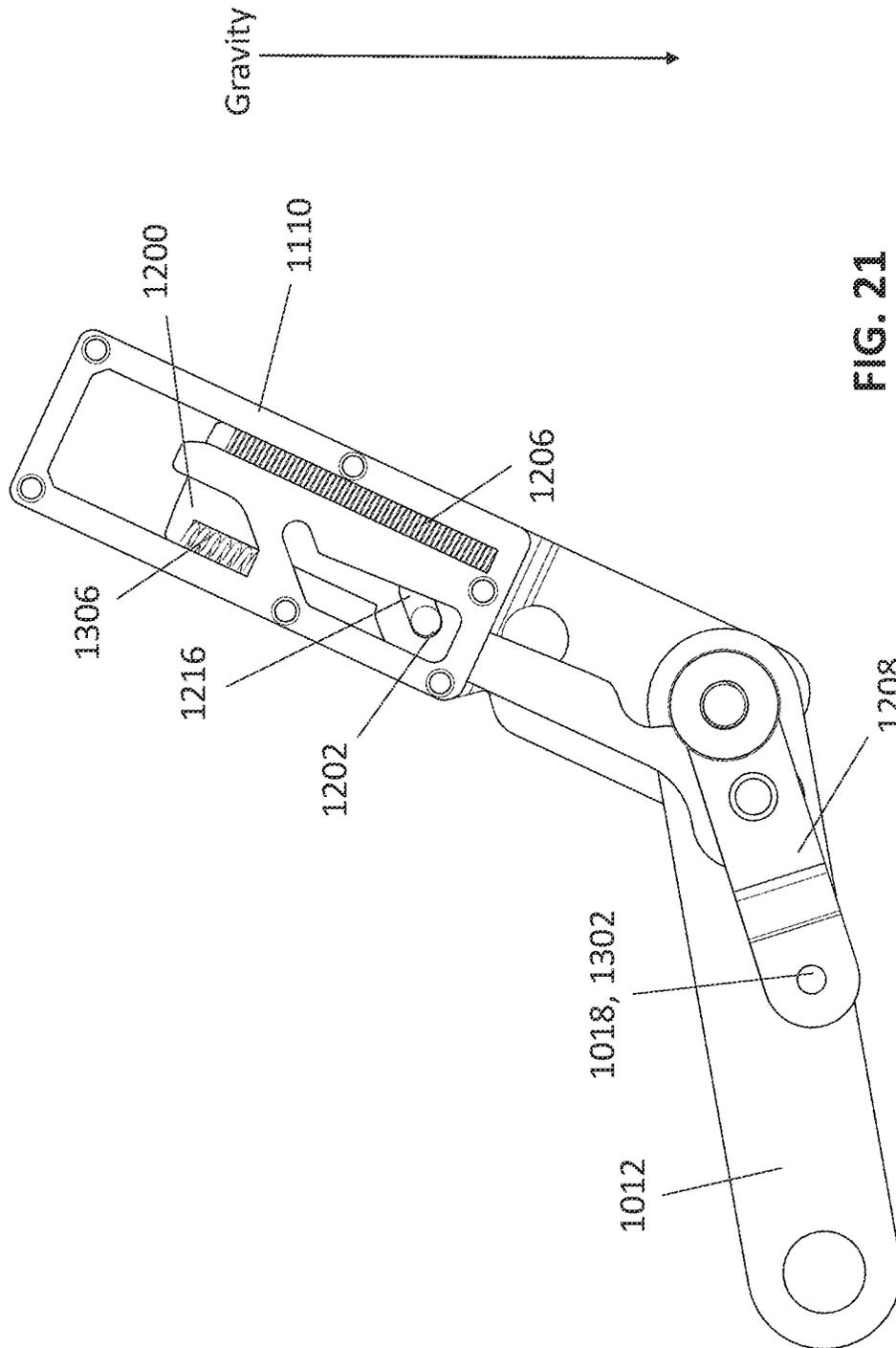


FIG. 20



**LOCKING DEVICE AND METHOD**CROSS-REFERENCE TO RELATED  
APPLICATIONS AND CLAIM TO PRIORITY

This application is a continuation-in-part of U.S. patent application Ser. No. 16/154,904, filed Oct. 9, 2018, which claims the priority of U.S. Provisional Patent Application No. 62/569,676, filed Oct. 9, 2017, the disclosures of which are incorporated herein by reference.

## FIELD OF THE INVENTION

The present invention generally relates to waste containers and, more particularly, to a locking device for waste containers. The locking device is gravity actuated to an opened position on tilting of the container for dumping.

## BACKGROUND OF THE INVENTION

As is well known, waste containers, such as refuse containers for use in residential and industrial applications, typically include a container supported on a base structure. With the advent of mechanized trash removal, there have been created a number of large sized trash bins or dumpsters. These containers usually comprise a block-shaped or pyramid-shaped container with a hinged lid attached to one side thereof. The container further includes attachments for accommodating various lifting mechanisms of a trash removal vehicle. Each container is lifted by the lifting mechanism of the trash removal vehicle and pivoted in some fashion, so that the hinged top of the container opens and the trash contained therein may be emptied into the vehicle. The container is then returned to a position on the ground, and the hinged lid closes on top of the container. Many of these large trash receptacles are rented from a trash removal service. These receptacles are not provided free of charge, and consequently their frequent emptying and service can become a considerable expense. This expense is increased when unauthorized users deposit trash therein. This unauthorized use necessitates a more frequent emptying of the container, and of course the unauthorized user does not contribute to the increased expense attributable to the need for more frequent dumping.

In order to reduce the added expense that comes from unauthorized use, the dumpster/container may be locked. While conventional chains and padlocks reduce unauthorized dumpster use, they also add to operating expenses because the driver of the truck emptying the dumpster must get out of the truck to unlock the padlock on the dumpster and then reverse the process after emptying. For decades, companies have been developing and marketing dumpster locking mechanisms that open automatically when the dumpster is lifted and inverted to dump the trash into the truck. With such as automatic lock, the driver is not required to leave the truck, which saves the trash company hundreds of dollars each year.

Conventional automatic locks are typically bulky, expensive and difficult to mount to multiple/different containers. Since containers come in a variety of shapes and sizes, it is important that the locking device be sized and shaped to be retrofit onto a variety of existing containers. Moreover, the locking device must be able to withstand the rigors of everyday, outdoor use in the waste environment.

Therefore, there exists a need for an automatic locking device that improves upon prior automatic locking devices and solves the problems inherent in known automatic locking devices.

## SUMMARY OF THE INVENTION

A first aspect of the invention provides a locking device for a container having a hinged lid. The container has a hinged lid that is movable between an upright storing position and a tilted dumping position for emptying the container. The locking device allows the lid of the container, when the container is in an upright position, to be locked to prevent unauthorized access to the container. When the container is tilted from the upright position, e.g. to empty the contents of the container, the locking device is gravity actuated to allow the lid to open.

The locking device contains a base unit and a pivotable unit pivotally mounted to the base unit. The base unit is adapted to be fixed to the container and contains a locking mechanism therein. The locking mechanism contains a sliding member, a rolling member, a biasing member, and a connecting member. The connecting member allows the locking mechanism to be connected to the pivotable unit. The rolling member is affected by gravity to be in the blocked position when the container is upright and in the unblocked position when the container is tilted past a predetermined angle. In the blocked position, the sliding member is blocked from sliding forwardly to allow the locking device to be placed in the opened position. In the unblocked position, the sliding member may slide forwardly to place the locking device in the opened position. The biasing member functions to retract the sliding member to the blocked position when dumping operation has completed.

A second aspect of the invention provides a container having a hinged lid over an opening thereof and a locking device mounted to a first side wall of the container. A support member is mounted to a second side wall, opposing the first side wall. The support member has a pivoting arm pivotally mounted thereto. A locking bar connects the pivoting unit and the pivoting arm. In the closed position, the locking bar is positioned over the hinged lid to prevent it from opening. In the open position, the locking bar is spaced away from the hinged lid to allow it to be lifted away from container, thereby opening the container.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are incorporated in and constitute a part of the specification. The drawings, together with the general description given above and the detailed description of the exemplary embodiments and methods given below, serve to explain the principles of the invention. The objects and advantages of the invention will become apparent from a study of the following specification when viewed in light of the accompanying drawings, in which like elements are given the same or analogous reference numerals and wherein:

3

FIG. 1 is a fragmentary perspective view from a side of a waste container in an upright position with a locking device in a close position;

FIG. 2 is a fragmentary perspective view of the waste container of FIG. 1 in a tilted position with the locking device in the open position;

FIG. 3 is a side view of a first embodiment of the locking device from the outer side;

FIG. 4 is a side view of the first embodiment of the locking device from the inner side;

FIG. 5 is an exploded view of the first embodiment of the locking device;

FIG. 6 is a side view of the first embodiment of the sliding member;

FIG. 7 is a side view of the first embodiment of the framing plate;

FIG. 8 is a side view of the first embodiment of the locking device from the inner side (with the anchor and inner plates removed);

FIG. 9 is a side view of the blocking plate of the first embodiment;

FIG. 10 is a side view of the first embodiment of the locking device from the inner side (with the inner plate removed);

FIG. 11 is a side view of the anchor plate of the first embodiment;

FIG. 12 is a rear view of the first embodiment of the locking device showing the assembly of the plates;

FIG. 13 is a side view of the first embodiment of the locking device from the inner side (with the anchor and inner plates removed) while being tilted;

FIG. 14 is a side view of the first embodiment of the locking device in the opened position from the inner side (with the anchor and inner plates removed);

FIG. 15 is a perspective view of a second embodiment of the locking device from the outer side (upright position);

FIG. 16 is a perspective view of the second embodiment of the locking device from the inner side (upright position);

FIG. 17 is an exploded view of the second embodiment of the locking device;

FIG. 18 is a perspective view of the second embodiment of the locking device from the inner side with the inner plate removed (upright position);

FIG. 19 is a perspective view of the second embodiment of the locking device from the inner side with the inner plate removed (upright position) with the pivotable unit rotated to the open position;

FIG. 20 is a side view of the second embodiment of the locking device from the inner side with the inner plate removed (tilted position); and

FIG. 21 is a side view of the second embodiment of the locking device from the inner side with the inner plate removed (tilted position) with the pivotable unit rotated to the open position.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Reference will now be made in detail to exemplary embodiments and methods of the invention as illustrated in the accompanying drawings, in which like reference characters designate like or corresponding parts throughout the drawings. It should be noted, however, that the invention in its broader aspects is not limited to the specific details, representative devices and methods, and illustrative examples shown and described in connection with the exemplary embodiments and methods.

4

This description of exemplary embodiments is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description, relative terms such as "horizontal," "vertical," "up," "down," "upper," "lower," "right," "left," "top," "bottom," "forward," and "backward" as well as derivatives thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in FIGS. 3-4 and 15-16. These relative terms are for convenience of description and normally are not intended to require a particular orientation. Terms concerning attachments, coupling and the like, such as "connected" and "interconnected," refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Additionally, the word "a" and "an" as used in the claims means "at least one" and the word "two" as used in the claims means "at least two".

FIGS. 1-2 illustrate a waste container 2, such as a trash collector or dumpster, including a container body 3, at least one hinged lid 4 pivotally mounted thereto, a safety locking device 10 and a locking bar 6 extending across the top of the waste container 2. The locking device 10 is provided for locking and unlocking the hinged lid 4 of the container 2 to prevent unauthorized access to it. The locking bar 6 extends between the locking device 10 at one end and a pivoting arm 8 at the other end of container body 3. The locking device 10 is preferably mounted to a side wall 3a of the container body 3 (herein defined as a lock side of the container body 3), while the pivoting arm 8 is preferably pivotally mounted to the opposite side wall 3b thereof (herein defined as a dummy side of the container body 3). Although the drawings show the lock side as the right side of the container body 3 and the dummy side (for mounting a support member) as the left side of the container body 3, the reverse is also within the scope of the present invention, where the lock side is the left side of the container body 3 and the dummy side is the right side of the container body 3. The lock side and the dummy side may be located anywhere on the container as long as the locking bar 6 may be positioned over the lid 4 to block the opening of the container 2, and moved to be spaced from the lid 4 to allow opening of the container 2. The locking device 10 may be mounted to a flanged lip 7 of the container body 3 or directly to a side of the container body 3.

The container 2, as illustrated in FIGS. 1-2, is generally an industrial-type dumpster used for retaining, storing, and eventually disposing of refuse (waste). The container 2 may be tilted or otherwise pivoted from an upright (or on-the-ground) position (wherein the waste container 2 is sitting generally horizontally on the ground) (shown in FIG. 1) to a tilted or dumping position (shown in FIG. 2).

As best shown in FIGS. 1-4 and 15-16 (FIGS. 3-4 depict a first embodiment and FIGS. 15-16 depict a second embodiment of the present invention), the locking device 10 (or 1010) contains a base unit 14 (or 1014) and a pivotable unit 12 (or 1012) pivotally coupled to the base unit 14 (or 1014). The pivotable unit 12 (or 1012) is preferably a bar having one end that is pivotally coupled to the base unit 14 (or 1014) by a coupling 11 (or 1011), e.g. by a rivet or a nut/bolt. The coupling 11 (or 1011) allows the pivotable unit 12 (or 1012) to rotate relative to the base unit 14 (or 1014) by pivoting around the coupling 11 (or 1011). The other end of the pivotable unit 12 (or 1012) preferably contains a hole 16 (or 1016) (see e.g., FIG. 3) for coupling to the locking bar 6,

when the locking device **10** (or **1010**) is mounted on the waste container **2**. Preferably, the locking bar **6** is fixed to the hole **16** (or **1016**) of the pivotable unit **12** (or **1012**) and extends approximately perpendicularly to the plane of the pivotable unit **12** (or **1012**).

The base unit **14** (or **1014**) includes a locking mechanism that is mounted in the interior of a housing **100** (or **1100**). The housing **100** (or **1100**) contains a forward end containing a tab **102** (or **1102**) (as best shown in FIG. 4 or 15) for coupling to the pivotable unit **12** (or **1012**). The housing **100** (or **1100**) may also contain throughholes **104** (or **1104**) for attaching the base unit **14** (or **1014**) to the container **2** with mechanical fasteners, such as screws, nuts/bolts, or rivets.

FIGS. 3-14 depicts a first embodiment of the locking device **10**. The locking mechanism of the first embodiment, as best shown in FIGS. 5 and 8, contains a sliding member **200**, a rolling member **202**, pivot levers **204a** and **204b**, a biasing member **206**, and a connecting member **208**. The sliding member **200** is a substantially flat plate mounted inside the housing **100** and slidable in a fore/aft direction relative to the housing **100**. As best shown in FIG. 6, the sliding member **200** contains a main body **210** and a neck portion **212** extending from the main body **210**, preferably at the forward end, and non-movable relative thereto.

The neck portion **212** preferably contains a hole **214** for pivotally coupling to a back end of the connecting member **208** with a mechanical fastener, such as a rivet or nut/bolt. The coupling of the neck portion **212** to the connecting member **208** allows the connecting member **208** to freely rotate around that coupling. The main body **210** contains a first slot **216** for receiving the rolling member **202** therein. The first slot **216** is angularly disposed in the main body **210** for receiving the rolling member **202**. The slot **216** is preferably angled at about 30 to 60° relative to the sliding direction of the sliding member **200**. The angle is such that, when the locking device **10** is in its upright and locked position, the rolling member **202** is pulled by gravity to the bottom of the first slot **216** (see FIG. 8); and when the locking device **10** is sufficiently tipped forward (tipped forward at a predetermined angle), gravity pulls the rolling member **202** to the top of the first slot **216** (see FIG. 13).

The rolling member **202** may be a spherical ball. Alternatively, the rolling member **202** may be a cylindrical disc, capable of rolling within the first slot **216**. It will be appreciated that the diameter of the rolling member **202** is the same or slightly smaller than a width  $W_c$  of the first slot **216** (as best shown in FIGS. 6 and 8), such that the rolling member **202** can roll freely within the first slot **216**. As explained below, when the rolling member **202** is located at the bottom of the first slot **216**, it cooperates with other parts within the housing **100** to block the sliding member **200** from sliding forwardly (the blocked position); and when the rolling member **202** is located at the top of the first slot **216**, the sliding member **200** may freely slides in the forward direction (the unblocked position).

The main body **210**, as best shown in FIGS. 5-6, also contains a second slot **218**, preferably toward the back of the sliding member **200** in relation to the first slot **216**, for coupling of the pivot levers **204a** and **204b** thereto. Although the drawings illustrate two pivot levers **204a** and **204b**, only one pivot lever is needed for the present invention. Henceforth, only one pivot lever is described and referred to as **204**, although two pivot levers, one on each side of the sliding member **200**, may also be used. The second slot **218** preferably has an upward crescent shape and is angularly disposed in the main body **210** for coupling with the pivot lever **204**. A line connecting the ends of the second slot **218**

is preferably angled at about 1 to about 89° relative to the sliding direction of the sliding member **200**, more preferably about 10 to about 70°, most preferably about 20 to about 50°. A top shaft **220**, passing through the second slot **218** and a hole at a top end of the pivot lever **204**, connects the pivot lever **204** to the sliding member **200**. The top shaft **220** is slidable within the second slot **218**, as best shown in FIG. 8. When the sliding member **200** is in its aftmost position, the pivot lever **204** is preferably in an approximately vertical (top/bottom direction) position. The pivot lever **204** is coupled to the biasing member **206** at its bottom end, preferably via a bottom shaft **222**, which passes through a hole at a bottom end of the pivot lever **204**. The biasing member **206** preferably is a spring that biases the bottom end of the pivot lever **204** in the forward direction. The pivot lever **204** pivots around a pivot shaft **224**, which preferably passes through a middle hole (located between the top and bottom holes) on the pivot lever **204**. The pivot shaft **224** is fixed relative to the housing **100** and allows the pivot lever **204** to pivot thereabout. The pivot shaft **224** preferably supports the bottom of the sliding member **200** and allows the sliding member **200** to slide thereon. As best illustrated in FIG. 8, the distance a between the top shaft **220** and the pivot shaft **224** is preferably greater than the distance b between the bottom shaft **222** and the pivot shaft. Thus, the a:b ratio is greater than 1, more preferably about 1.3:1 to about 5:1, most preferably about 1.5:1 to about 3:1. The preferred ranges given for the a:b ratio are based upon practical considerations, but a high ratio is most desirable.

As best shown in FIGS. 3 and 5, the connecting member **208** contains a hole **225** on the aft end for coupling to the neck portion **212** of the sliding member **200**, as discussed above. The forward end of the connecting member contains a hole **226** matching a hole **18** on the pivotable unit **12**. A pad lock **9**, as best shown in FIG. 1, may engage both holes **226** and **18** to lock the pivotable unit **12** to the locking mechanism to prevent unauthorized access to the interior of the container **2**. As shown in FIG. 5, the connecting member **208** may be formed as a flat bar; however, the connecting member **208** may also be a metal rod or a stiff member of various shapes.

As best illustrated in FIG. 5, the housing **100** is preferably made up of several substantially flat plates which are assembled to form the housing **100**. The plates may be assembled together with mechanical fasteners, such as rivets, bolts/nuts, or screws, without requiring welds. The plates include an outer plate **106**, framing plates **108a** and **108b**, blocking plates **110a** and **110b**, anchor plates **112a** and **112b**, and an inner plate **114**. The outer plate **106** is the outermost plate farthest from the container **2** when the locking device **10** is mounted on the container **2**. The pivotable unit **12** is mounted to the end tab **102** of the outer plate **106**. The inner plate **114** is the innermost plate locating adjacent to the container **2** when the locking device **10** is mounted on the container **2**. As used herein, "inner," "inner side," or the like refers to the side of the locking device that is closest to the container **2** when the locking device **10** is mounted on the container **2**; and "outer," "outer side," or the like refers to the side of the locking device that is farthest from the container **2** when the locking device **10** is mounted on the container **2**. Between the inner plate **114** and the outer plate **106**, from the center out, are the framing plates **108a** and **108b**, the blocking plates **110a** and **110b**, and the anchor plates **112a** and **112b**. Thus, the framing plates **108a** and **108b** are located at the center and adjacent to each other; the blocking plate **110a** is adjacent to the framing plate **108a**; the blocking plate **110b** is adjacent to the framing plate **108b**; the

anchor plate **112a** is adjacent to the blocking plate **110a**; and the anchor plate **112b** is adjacent to the blocking plate **110b**. Because the framing plates **108a** and **108b** are mirror images of each other, only one plate will be discussed in detail below. The same is also true of the blocking plates **110a** and **110b**, and the anchor plates **112a** and **112b**.

FIG. 7 illustrates the details of the framing plate **108**. The framing plate **108** has a hollow center **109**, frames the perimeter of the housing **100**, and contains a perimeter cutout portion **116**. When assembled, the cutout portion **116** forms an opening to allow the sliding member **200** to protrude therethrough so that the neck portion **212** is located outside of the housing **100** so that the neck portion **212** with the hole **214** is disposed outside the housing **100** (see FIGS. **8**, **10**, **13** and **14**). The opening formed by cutout portion **116** also allows a portion of the sliding member **200** to slide in and out of the housing **100** (compare FIGS. **8** and **14**). The framing plate **108** also include a hole **118** for coupling of the biasing member **206** thereto. Thus, one end of the biasing member **206** is coupled to the hole **118** on the framing plate, while the other end of the biasing member **206** is coupled to the bottom shaft **222** or directly to the bottom portion of the pivot lever **204**.

FIG. 9 illustrates the details of the blocking plate **110**. The blocking plate **110** contains a L-shaped cutout **120**. The cutout **120** contains a substantially horizontal long leg **120l** and a substantially vertical short leg **120s**. The short leg **120s** contains an angled or slanted surface **122** matching the angle of the first slot **216** in the sliding member **200**. When the locking device **10** is in its closed position and upright (as best shown in FIG. **8**), the angled surface is in registry with the first slot **216**. In that orientation, the rolling member **202** is in its blocked position (at the bottom of the first slot **216**), such that the rolling member **202** spans the thickness of sliding member **200** and protrude into the blocking plate **110**, and is lodged in the short leg **120s** behind the angled surface **122** (as best illustrated in FIG. **8**). In that position, the angled surface **122** and the rolling member **202** cooperate to block the sliding member **200** from sliding in the forward direction. The blocking plate **110** may also contain a large cutout **124** to accommodate parts of the locking mechanism, such as the biasing member **206** and the pivot lever(s) **204**. The large cutout **124** also reduces the weight of the locking device **10**.

FIG. 11 illustrates the details of the anchor plate **112**. The main function of the anchor plate **112** is to provide an anchor point for fixing the pivot shaft **224** to the housing **100**. Accordingly, the anchor plate **112** preferably contains a hole **126** for anchoring one end of the pivot shaft **224** and to fix the pivot shaft **224** in place. The pivot shaft **224** passes perpendicularly through the hole **126** and is retained therein, preferably by friction. The hole **126** fixes the pivot shaft **224** in place to allow the pivot lever **204** to pivot thereon. As shown in FIGS. **10-11**, the anchor plate **112** may also have hollow cutouts **128** and **130**. Those cutouts **128** and **130** reduce the overall weight of the locking device **10**, but do not have a locking function.

Each of the plates preferably contains matching holes **132** for assembly of the housing by mechanical fasteners. For assembly, the plates are stacked so that matching holes **132** are aligned with each other; and fasteners, such as rivets, are inserted through the holes to secure the plates together. The order of the plates from the outer side to inner side, as best shown in FIG. **12**, is as follows: the outer plate **106**, the anchor plate **112a**, the blocking plate **110a**, the framing plate **108a**, the framing plate **108b**, blocking plate **110b**, the anchor plate **112b**, and the inner plate **114**. Essentially, the

housing **100** contains two halves: 1) an inside half containing the framing plate **108b**, the blocking plate **110b**, the anchor plate **112b**, and the inner plate **114**; and 2) an outside half containing the framing plate **108a**, the blocking plate **110a**, the anchor plate **112a**, and the outer plate **106**. The two halves are assembled together to contain the locking mechanism therebetween. Although several plates are described herein as an exemplary embodiment, a skilled person in the art would recognize that the functions of two or more plates may be combined into a single plate. For example, the blocking plate **110** and the anchor plate **112** may be combined as a single plate, or the anchor plate **112** and the outer plate may be combined as single plate, or all the plates on one half of the lock may be combined so that the lock includes two assembled halves. The multiple plate design allows the locking device **10** to be assembled without welding and to reduce weight.

In use, to prevent unauthorized access to the interior of the container, the lock **9**, such as a padlock, as best shown in FIG. **1**, is placed through the hole **18** of the pivotable unit **12** and the hole **226** of the connecting member **208**. When the lock is in place and the container **2** is in its upright position (FIG. **1**), the pivotable unit **12** cannot be rotated away from the container to its opened position, because the rolling member **202** is in its blocking position at the bottom of the first slot **216** (FIG. **8**). In that position, the rolling member **202** abuts against the angled surface **122** in the blocking plate **110**, preventing the sliding member **200** from sliding forwardly. To manually open the container, the lock may be removed from holes **18** and **226** to disconnect the pivotable unit **12** from the locking mechanism, thereby allowing a user to manually rotate the pivotable unit **12** forward and away from the lid **4** to the opened position.

When it is desirable to remove the contents of the container **2** while the lock is in place, the container **2** may be grabbed by a lifting mechanism, e.g. of a waste collection truck (not shown), and moved from the upright position (FIG. **1**) to the tilted or dumping position (FIG. **2**). When in the upright position, the rolling member **202** is in the blocking position (as shown in FIG. **8**). Accordingly, the pivotable unit **12** is prevented from pivoting to its open position. However, when the waste container **2** is tipped forward, gravity pulls the rolling member **202** from the blocking position (shown in FIG. **8**) to the release position (shown in FIG. **13**). In the release position, the rolling member **202** is freed from the angled surface **122** and no longer obstructs the forward displacement of the sliding member **200**. Consequently, the pivotable unit **12** may pivot (by gravity on the pivotable unit **12** and the locking bar **6**) to its open position, as shown in FIG. **14**. The pivotable unit **12** may rotate by gravity from the closed position to the open position. As the pivotable unit **12** rotates forwardly, the sliding member **200**, which is connected to the pivotable unit **12** via the connecting member **208** and the lock, is linearly displaced in the forward direction (as shown in FIG. **14**). The lid **4** of the waste container **2** may then swing open by gravity, permitting the contents of the waste container **2** to be emptied. When the sliding member **200** slides forwardly, the pivot lever **204** pivots on the pivot shaft **224**, allowing the top shaft **220** to slide within the second slot **218** toward the bottom end of the second slot **218** (FIG. **14**). In that position, because of the a:b ratio, the biasing force pulling on the pivot lever **204** (and thus the sliding member **200**) is not sufficient to overcome the gravitational force on the pivotable unit **12**. That way, as the waste stream is being emptied from the container **2**, the pivotable unit **12** and the locking bar **6** are not pulled into that waste stream. When the

container 2 is returned to its upright position, the biasing member 206 pulls sliding member 200 aft, by acting on the pivot lever 204, thereby pulling the pivotable unit into the closed position. In the upright, closed position, gravity pulls the rolling member 202 to its blocking position at the bottom of the first slot 216.

FIGS. 15-21 depicts a second embodiment of the locking device 1010. Elements of the second embodiment receive reference numerals that are 1000 more than the reference numerals for corresponding elements in the first embodiment. For example, the pivotable unit 1012 of the second embodiment corresponds to the pivotable unit 12 of the first embodiment. The second embodiment may not contain all elements of the first embodiment and vice versa. The second embodiment may contain elements that are not found in the first embodiment and vice versa.

Thus, similar to the first embodiment, the second embodiment of the locking device 1010 contains a base unit 1014, a pivotable unit 1012 coupled to the base unit 1014 by a coupling 1011, e.g. a rivet or a nut/bolt. The other end of the pivotable unit 1012 preferably contains a hole 1016 for coupling to the locking bar 6, when the locking device 1010 is mounted on the waste container 2.

The base unit 1014 includes a locking mechanism that is mounted in the interior of a housing 1100. The housing 1100 contains a forward end containing a tab 1102 (as best shown in FIG. 15) for coupling to the pivotable unit 1012. The housing 1100 may also contain throughholes 1104 for attaching the base unit 1014 to the container 2 with mechanical fasteners, such as screws, nuts/bolts, or rivets.

The locking mechanism of the second embodiment, as best shown in FIG. 17, contains a sliding member 1200, a rolling member 1202, a biasing member 1206, and a connecting member 1208. The sliding member 1200 is a substantially flat plate mounted inside the housing 1100 and slidable in a fore/aft direction relative to the housing 1100. As best shown in FIG. 17, the sliding member 1200 contains a main body 1210 and a neck portion 1212 extending from the main body 1210, preferably at the forward end. The neck portion 1212 preferably contains a hole 1214 for pivotally coupling to the connecting member 1208 with a mechanical fastener, such as a rivet or nut/bolt. The coupling of the neck portion 1212 to the connecting member 1208 allows the connecting member 1208 to freely rotate around that coupling. The main body 1210 contains a first slot 1216 for receiving the rolling member 1202 therein. The first slot 1216 is angularly disposed in the main body 1210 for receiving the rolling member 1202, in the same manner as the first slot 216 of the first embodiment. Thus, the angle of the first slot 1216 is preferably the same as that for the first slot 216. The angle is such that, when the locking device 1010 is in its upright and locked position, the rolling member 1202 is pulled by gravity to the bottom of the first slot 1216 (see FIG. 18); and when the locking device 1010 is sufficiently tipped forward (tipped forward at an angle, preferably about 30 to about) 60°, gravity pulls the rolling member 1202 to the top of the first slot 1216 (see FIG. 20).

The rolling member 1202 is preferably identical to the rolling member 202 of the first embodiment described above.

As best shown in FIGS. 16-17, the connecting member 1208 preferably is in the shape of a bar mounted substantially parallel to the pivotable unit 1012. As best shown in FIG. 17, the connecting member 1208 contains three holes: a bottom hole 1300, a top hole 1302, and a middle hole 1304 between the top and bottom holes 1302 and 1300. The bottom hole 1300 allows the bottom of the connecting

member 1208 to be pivotably mounted to the pivotable unit 1012 by the coupling 1011. The coupling 1011 forms a fixed point allowing the pivotable unit 1012 and the connecting member 1208 to pivot relative to each other and relative to the base unit 1014. The middle hole 1304 allows for coupling of the neck portion 1212 of the sliding member 1200 to the connecting member 1208, e.g., by a fastener, such as a nut/bolt, screw, rivet, etc. The coupling at the middle hole 1304 allows the connecting member 1208 and the neck portion 1212 to pivot relative to each other by rotating around the coupling. The top hole 1302 at the top end of the connecting member matches a hole 1018 on the pivotable unit 1012. A pad lock 1009, such as shown in FIG. 18, or the like, may engage both holes 1302 and 1018 to lock the pivotable unit 1012 to the locking mechanism to prevent unauthorized access to the interior of the container 2. Although the Figures show the connecting member 1208 as a bar, the connecting member 1208 may also be a metal rod or a stiff member of various shapes.

Like the first embodiment, the housing 1100 of the second embodiment is preferably made up of several flat plates. As shown in FIG. 17, the plates of the second embodiment preferably includes an outer plate 1106, framing plates 1108a and 1108b, blocking plates 1110a and 1110b, and an inner plate 1114. The outer plate 1106 is the outermost plate farthest from the container 2 when the locking device 1010 is mounted on the container 2. The pivotable unit 1012 is mounted to the end tab 1102 of the outer plate 1106. The inner plate 1114 is the innermost plate located adjacent the container 2 when the locking device 1010 is mounted on the container 2. Between the inner plate 1114 and the outer plate 1106, from the outside in, are the first blocking plate 1110a, the first framing plate 1108a, the second framing plate 1108b, and the second blocking plate 1110b. Thus, the framing plates 1108a and 1108b are located at the center and adjacent to each other; the first blocking plate 1110a is sandwiched between the first framing plate 1108a and the outer plate 1106; the second blocking plate 1110b is sandwiched between the second framing plate 1108b and the inner plate 1114. Because the framing plates 1108a and 1108b are mirror images of each other, only one plate will be discussed in detail below. The same is also true of the blocking plates 1110a and 1110b.

The framing plate 1108 is substantially the same as the framing plate 108 of the first embodiment. The framing plate 1108 has a hollow center 1109, frames the perimeter of the housing 1100, and contains a perimeter cutout portion 1116. When assembled, the cutout portion 1116 forms an opening to allow the sliding member 1200 to protrude therethrough so that the neck portion 1212 is located outside of the housing 1100 so that the neck portion 1212 with the hole 1214 is disposed outside the housing 1100 (see, e.g., FIGS. 17-21). The opening formed by cutout portion 1116 also allows a portion of the sliding member 1200 to slide in and out of the housing 100 (compare FIGS. 18 and 21).

Similar to the blocking plate 110 of the first embodiment, the blocking plate 1110 of the second embodiment, as best shown in FIG. 17, contains a L-shaped cutout 1120. The cutout 1120 contains a horizontal long leg 1120l and a vertically angled short leg 1120s. The short leg 1120s contains an angled or slanted surface 1122 matching the angle of the first slot 1216 in the sliding member 1200. Although the short leg 1120s of the L-shaped cut out 1120 is shown in FIG. 17 as matching the first slot 1216, it may also have the same configuration as that of the short leg 120s of the first embodiment as long as the angled surface 1122

11

is present. Likewise, the short leg **120s** of the first embodiment may also have the same configuration as the short leg **1120s** shown in FIG. 17.

When the locking device **1010** is in its closed position and upright (as best shown in FIG. 18), the angled surface **1122** is in registry with the first slot **1216**. In that position, as explained above for the first embodiment, the rolling member **1202** is in its blocked position (at the bottom of the first slot **1216**), such that the rolling member **1202** spans the thickness of sliding member **1200** and protrudes into the blocking plates **1110a** and **1110b**, and is lodged in the short leg **1120s** behind the angled surface **1122** (as best illustrated in FIG. 18). In that position, the angled surface **1122** and the rolling member **1202** cooperate to block the sliding member **1200** from sliding in the forward direction. The blocking plate **1110** may also contain a large cutout **1124** to accommodate parts of the locking mechanism, such as the biasing member **1206**. Preferably, the large cut out **1124** includes a top portion **1124t** and a bottom portion **1124b**. The bottom portion **1124b** is configured to accommodate the biasing member **1206**. The top portion **1124t** is configured to accommodate an optional second biasing member **1306**. The biasing members **1206** and **1306** are explained in further detail below.

As in the first embodiments, the plates **1106**, **1110a**, **1110b**, **1108a**, **1108b**, and **1114** are assembled with fastener (s), such as rivet(s), placed through their matching holes **1132** after stacking the plates **1106**, **1110a**, **1110b**, **1108a**, **1108b**, and **1114** so that the matching holes **1132** are aligned with each other. The order of the plates for the second embodiment, from the outer side to inner side, as best shown in FIG. 17, is as follows: outer plate **1106**, the first blocking plate **1110a**, the first framing plate **1108a**, the second framing plate **1108b**, the second blocking plate **1110b**, and the inner plate **1114**. The assembled plates contain the locking mechanism therebetween. Although several plates are described herein as an exemplary embodiment, a skilled person in the art would recognize that the functions of two or more plates may be combined into a single plate.

When assembled, the sliding member **1200**, the rolling member **1202**, and the biasing member **1206** are housed within the housing **1100** formed by the plates. As best shown in FIGS. 18-21, the biasing member **1206** is positioned within the bottom portion **1124b** of the large cut out **1124** of the blocking plates **1110a** and **1110b**, and has a front end that abuts the housing **1100** and a rear end that abuts the sliding member **1200**. The biasing member **1206** preferably is a spring that biases the sliding member **1200** in the backward direction. The biasing member **1206** preferably has its rear end abutting the sliding member **1200** and its front end abutting the housing **1100**. The biasing member **1206** is constantly in a compressed (albeit not complete compression) state, so that even when the sliding member **1200** is in its rearmost position, the biasing member **1206** still abuts the sliding member **1200** and the housing **1100**.

In use, to prevent unauthorized access to the interior of the container **2**, the lock **1009**, such as a padlock, as best shown in FIG. 18, is placed through the hole **1018** of the pivotable unit **1012** and the hole **1302** of the connecting member **1208**. When the lock is in place and the container **2** is in its upright position (FIG. 1), the pivotable unit **1012** cannot be rotated away from the container **2** to its opened position, because the rolling member **1202** is in its blocking position at the bottom of the first slot **1216** (see FIG. 18). In that position, the rolling member **1202** abuts against the angled surface **1122** in the blocking plate **1110**, preventing the sliding member **1200** from sliding forwardly. To manually open the con-

12

tainer, the lock may be removed from holes **1018** and **1302** to disconnect the pivotable unit **1012** from the locking mechanism, thereby allowing a user to manually rotate the pivotable unit **1012** forward and away from the lid **4** to the opened position (see FIG. 19).

When it is desirable to remove the contents of the container **2** while the lock is in place, the container **2** may be grabbed by a lifting mechanism, e.g. of a waste collection truck (not shown), and moved from the upright position (FIG. 1) to the tilted or dumping position (FIG. 2). When in the upright position, the rolling member **1202** is in the blocking position (as shown in FIG. 18). Accordingly, the pivotable unit **1012** is prevented from pivoting to its open position. However, when the waste container **2** is tipped forward, gravity pulls the rolling member **1202** from the blocking position (shown in FIG. 18) to the release position (shown in FIG. 20). In the release position, the rolling member **1202** is freed from the angled surface **1122** and no longer obstructs the forward displacement of the sliding member **1200**. Consequently, the pivotable unit **1012** may pivot (by gravity on the pivotable unit **1012** and the locking bar **6**) to its open position, as shown in FIG. 21. The pivotable unit **1012** may rotate by gravity from the closed position to the open position. As the pivotable unit **1012** rotates forwardly, the sliding member **1200**, which is connected to the pivotable unit **1012** via the connecting member **1208** and the lock, is linearly displaced in the forward direction (as shown in FIG. 21), while at the same time compressing the biasing member **1206**, which may be a coil spring. The lid **4** of the waste container **2** may then swing open by gravity, permitting the contents of the waste container **2** to be emptied.

In certain embodiments, the force pulling the sliding member **1200** forwardly may be too strong, even for the compressed biasing member **1206**, and may slam the sliding member **1200** into parts of the housing **1100** causing damage to the housing **1100** and/or the sliding member **1200**. To cushion the slamming of the sliding member **1200**, the second biasing member **1306** may be used. The second biasing member **1306** floats (i.e., is disposed) on top of the sliding member **1200** and within the top portion **1124t** of the large cutout **1124** of the blocking plates **1110a**, **1110b**. As the sliding member **1200** slides forward, the free end (front end) of the second biasing member **1306** contacts the housing **1100** instead of the sliding member **1200** to cushion and to prevent the slamming of the sliding member **1200** against the housing **1100** (see FIG. 21). The second biasing member **1306** is preferably a stiff coil spring having a spring constant greater than the spring constant of the biasing member **1206**. When the container **2** is returned to its upright position, the compressed biasing member **1206** pushes sliding member **1200** aft, thereby pulling the pivotable unit **1012** into the closed position. In the upright, closed position, gravity pulls the rolling member **1202** to its blocking position at the bottom of the first slot **1216** (see FIG. 18).

Although certain presently preferred embodiments of the invention have been specifically described herein, it will be apparent to those skilled in the art to which the invention pertains that variations and modifications of the various embodiments shown and described herein may be made without departing from the spirit and scope of the invention. Accordingly, it is intended that the invention be limited only to the extent required by the appended claims and the applicable rules of law.

What is claimed is:

1. A locking device, comprising:
  - a) a housing having an opening;

13

- b) a flat and unitary sliding member slidably mounted in the housing, the sliding member having a main body and a neck portion extending from the main body, the main body and neck portion non-movable relative to each other, the main body having a first slot angularly disposed therein, the sliding member protruding through the opening in the housing so that the neck portion is disposed outside the housing;
  - c) a rolling member disposed in the first slot, wherein the rolling member is carried by the sliding member as the sliding member slides in a fore/aft direction relative to the housing; and
  - d) a biasing member disposed within the housing and biasing the sliding member in a first direction.
2. The locking device of claim 1, wherein the neck portion has a hole therethrough disposed outside the housing.
  3. The locking device of claim 2, wherein the biasing member is a spring having a first end abutting the sliding member and a second end abutting the housing.
  4. The locking device of claim 2, wherein the housing comprises a plurality of plates stacked together.
  5. The locking device of claim 4, wherein the plurality of plates comprises an outer plate, a first blocking plate, a first framing plate, a second framing plate, a second blocking plate, and an inner plate, and the plates are stacked in the following sequential order: the outer plate, the first blocking plate, the first framing plate, the second framing plate, the second blocking plate, and the inner plate.
  6. The locking device of claim 5, wherein the first and second blocking plates are mirror images of each other, and the first and second framing plates are mirror images of each other.
  7. The locking device of claim 5, wherein each of the first and second framing plates comprises a hollow center, and a perimeter cutout portion that forms the opening in the housing when the plates are assembled.
  8. The locking device of claim 5, wherein each of the first and second blocking plates contains a L-shaped cutout having a horizontal long leg and a vertically angled short leg, the short leg contains an angled surface in registry with the angle of the first slot on the sliding member, wherein when the rolling member is positioned at the bottom of the first slot, the rolling member is in contact with the angled surface to block the sliding member from sliding relative to the housing.
  9. The locking device of claim 4, wherein the plates are held together by rivets, screws, nuts and bolts, or combinations thereof.
  10. The locking device of claim 2, further comprising a pivotable unit and a connecting member, with a mechanical fastener extending through the hole in the neck portion of the

14

- sliding member, and wherein the connecting member is configured to couple the sliding member to the pivotable unit with a lock.
11. The locking device of claim 10, wherein the connecting member is a plate or a rod.
  12. The locking device of claim 11, wherein a first end of the connecting member is pivotably coupled to the pivotable unit, a second end is configured to couple to the pivotable unit with the lock, and a middle portion between the first and second ends is coupled to the neck portion of the sliding member.
  13. The locking device of claim 12, wherein when the second end is coupled to the pivotable unit with the lock, the connecting member is parallel to the pivotable unit.
  14. The locking device of claim 1, wherein when the rolling member is positioned at a bottom portion of the first slot, the sliding member is blocked from sliding forwardly.
  15. The locking device of claim 1, further comprising a second biasing member disposed in a space on top of the sliding member.
  16. A container assembly, comprising:
    - a) a container body;
    - b) a hinged lid pivotally mounted to the container body; and
 the locking device of claim 1 mounted to the container body.
  17. The container assembly of claim 16, further comprising:
    - a) a support member mounted to the container body opposing the locking device;
    - b) a pivoting arm pivotally mounted to the support member; and
    - c) a locking bar having a first end fixed to a pivotable unit and a second end fixed to the pivoting arm, wherein when the pivotable unit is in a closed position, the locking bar is positioned over the hinged lid to prevent access to the container body, and when the pivotable unit is in an open position, the locking bar is spaced away from the hinged lid to allow opening of the container.
  18. The container assembly of claim 17, wherein the locking bar is fixed to an end of the pivotable unit so as to extend perpendicularly to the plane of the pivotable unit.
  19. The locking device of claim 1, wherein the sliding member is formed as a single-piece component.
  20. A method for making a waste container, comprising the steps of:
    - a) providing a container body with a hinged lid pivotally mounted to the container body; and
    - b) mounting the locking device of claim 1 to the container body.

\* \* \* \* \*